Curriculum Overview

BACHELOR'S PROGRAM IN CHEMISTRY
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS NEGERI JAKARTA

A. OBJECTIVES OF THE DEGREE PROGRAM

A.1 VISION OF UNIVERSITY

Becoming a Reputable University in the Asian Region

A.2 MISSION OF UNIVERSITY

Organizing the Tridharma of Higher Education that is Excellent and Useful for the Benefit of Humans. The mission of UNJ is stated in the Decree of Minister of Research, Technology and Higher Education No. 44 Year 2018, article 25 about UNJ Statute. The mission is a step and guidance to organize the university to achieve its vision of becoming a reputable university in the Asian region. Some fundamental values applied in organizing UNJ are as follows: (1). Truth and Wisdom; (2) Academic Integrity; (3) Democratic and Humanist; (4) Diversity and Equality; (5) Beneficial for Humanity; (6) Sustainability. Implementation of the UNJ mission is directed to achieve university goals, such as to create a smart, advanced, and civilized society through science and technology development, application, and expansion.

To achieve the vision, mission and aims, UNJ has arranged: (a) a long-term development plan that consist of plans and development program for 25 years; (b) strategic plan that consist of plans and development program for 5 years; and (c) operational plan that consist of strategic plan explanation for one year of lists of program and activity

A.3 VISION OF FACULTY

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.

A.4 MISSION OF FACULTY

1. To conduct a certified education and teaching activity by using information technology and communication to create a graduate who is compliant with stakeholder requirement and able to contend in ASEAN(ASIA) level.
2. To build conducive academic circumstances, generating religious circumstances during academic and non-academic activity, and growing entrepreneurship ability for the students.
3. To conduct research and developments in Mathematics and Science study program, and Mathematics and Science Education study program in accordance with development of science and technology.
4. To conduct community services relevant to Mathematics and Science study program, and Mathematics and Science Education study program.
5. To establish and develop a partnership with various institutions, both national and international institutions.

A.5 THE VISION OF THE UNDERGRADUATE CHEMISTRY STUDY PROGRAM

To become one of the undergraduate chemistry study programs that produce professional chemistry graduates who can compete for ASIAN level, are responsive to the development of science and technology, and have social and environmental awareness.

A.6 THE MISSIONS OF THE UNDERGRADUATE CHEMISTRY STUDY PROGRAM

1. Organizing professional education in chemistry based on morals and ethics to produce independent graduates, have chemistry expertise, and continue their education at a higher level.
2. Carry out research that is useful for deepening and developing MIPA sciences, especially in chemistry (biosciences and materials chemistry).
3. Carry out community service to develop sensitivity and social responsibility of all academics, based on the scientific field they are engaged in.
4. Cooperating with various parties in developing institutions and human resources

B. PROGRAM EDUCATIONAL OBJECTIVES (PEO)

Program Education Objectives of the Chemistry Study Program are to produce graduates who become scientists, academics, industry experts, and entrepreneurs at the beginning of their careers. The program provides the opportunity for graduates to be able to:

1. have substantial knowledge, skill, and competency for problem-solving in chemistry to advance in diverse career paths or pursue a higher degree in chemistry
2. be professionals with appropriate soft skills and excellent work ethics
3. demonstrate a professional attitude, integrity, and high responsibility to the community and global society.

The relationship between Courses and Qualification Profile to reach PEO show in Figure 1 below

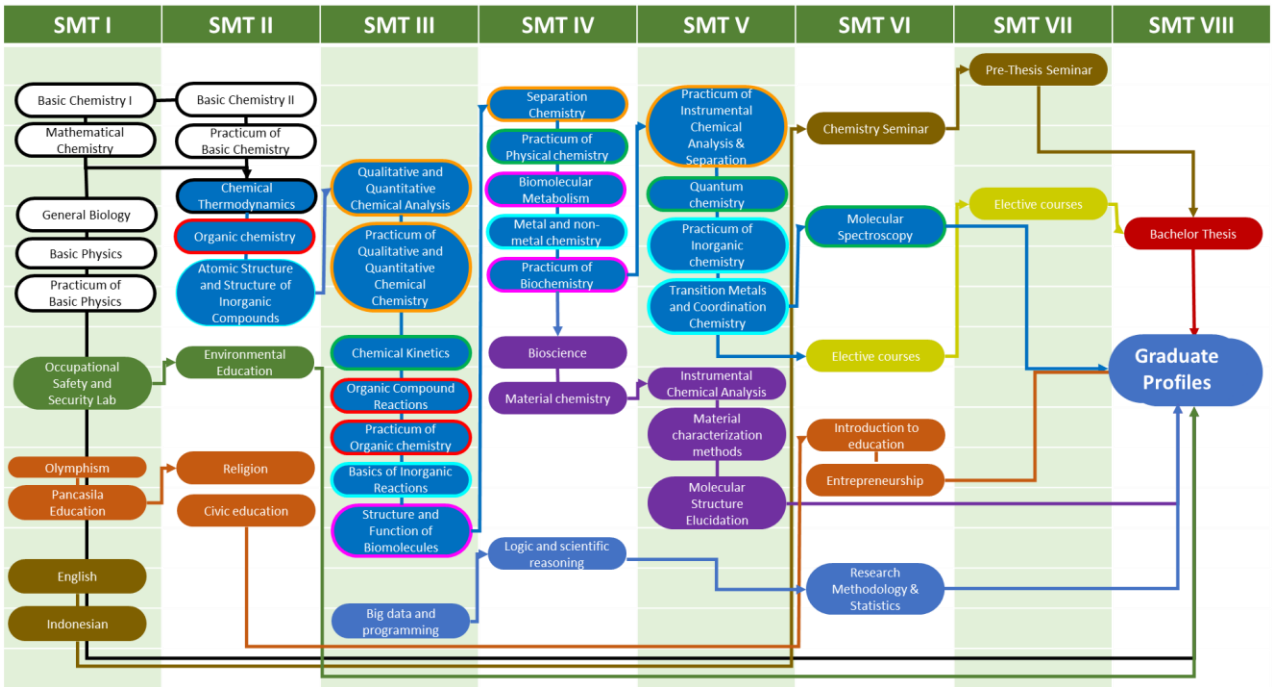

Figure 1. Course Flow: Correlation Courses and Qualification Profile

C. PROGRAM LEARNING OUTCOMES (PLO)

General procedures of graduate profile formation, learning outcome, and curriculum of study program have been in accordance with the standard (from guidelines of curriculum development, such as Higher Education and Profession Association, KKNI, Accreditation Bureau, and Association Profession of Study Program) as presented in Figure 2 and verified by academic board of faculty. The procedure involves both internal and external stakeholders, including academic staff, university and faculty supporter, alumni, students, experts, and external stakeholders.

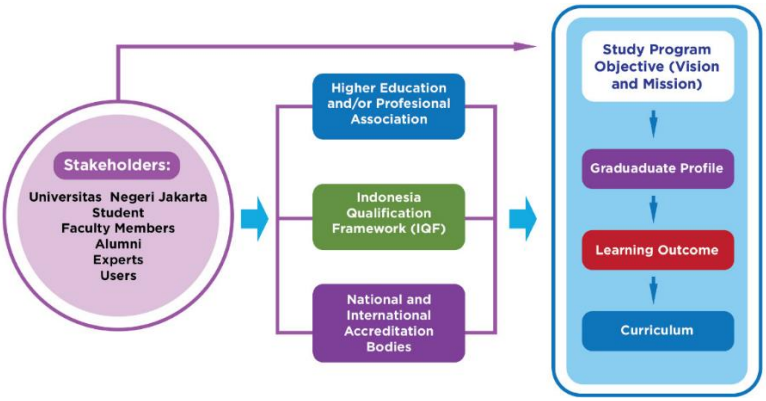

Figure 2 Design of Mechanism Scheme of Program Learning Outcomes

Learning Outcomes of bachelor's degree of Chemistry Study Program are presented in Table1. The PLOs are classified into two areas, namely social competence, and specialist competence.

Table 1. PLO of bachelor's degree of Chemistry Study Program

Area	Code	Program Learning Outcome
Social Competence	PLO 1	Be able to demonstrate internalized academic and humanity values.
	PLO 2	Be able to demonstrate excellence, honesty, competitiveness, leadership, and possessing social sensitivity to society and the environment.
	PLO 3	Be able to demonstrate performance independently or as part of a team professionally and measurably by applying interdisciplinary knowledge and skill, critical, and creative thinking in the context of being a life-long learner.
	PLO 4	Have the ability to compile scientific papers based on the analysis of information and research data and communicate them in an oral or written format to scientists and the wider public.
Specialist competences	PLO 5	Be able to integrate mathematical and basic concepts of science to solve problems in chemistry.
	PLO 6	Be able to master the knowledge of chemistry (organic and inorganic chemistry, analytical, physical, and biochemical), which includes structure, properties, functions, changes, energy and dynamics, identification, separation, characterization, transformation, and synthesis of micromolecular chemicals and their application.
	PLO 7	Be able to understand concepts and applications in the field of biosciences and materials chemistry to solve problems in the field of chemistry and its applications.

Area	Code	Program Learning Outcome
	PLO 8	Be able to understand operational knowledge about functions, how to operate chemical instruments, and analysis of data and information from these instruments.
	PLO 9	Be able to understand work safety, ethics, environmental issues, and policies related to the chemical field.
	PLO 10	Be able to carry out laboratory and research work by paying attention to the safety and security of laboratory work and applying responsible scientific behavior.
	PLO 11	Be able to obtain, process, interpret, and evaluate scientific data and produce conclusions by considering scientific and technological aspects and scientific ethics.
	PLO 12	Be able to solve science and technology problems in chemistry independently based on relevant scientific methodologies and to present it as a scientific work.

The relation of PLO and PEO of bachelor's degree of chemistry study program is described in the matrix below.

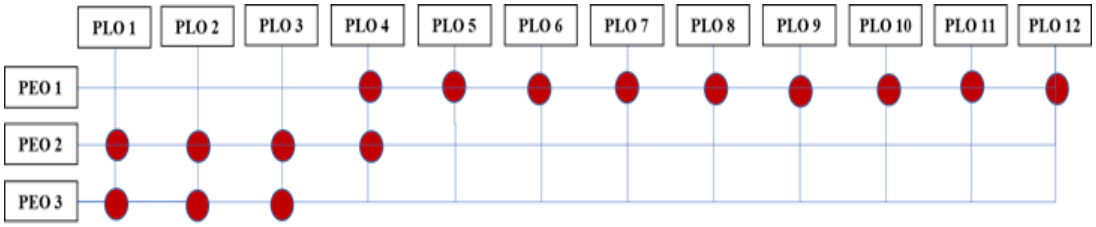

Figure 3 Matrix of PLO and PEO of bachelor's degree of Chemistry Study Program

Subject-specific criteria are developed based on the classification of chemistry study program body of knowledge and its PLO during the course determination. The description of Subject-Specific Criteria (SSC) for the Chemistry Study Program and Chemistry Education Study Program is presented below:

Table 2. SSC of Chemistry Study Program and Chemistry Education Study Program

SSC (Subject-Specific Criteria)		
Specialist competences	**SSC 1**	Have gained chemistry-relevant fundamental knowledge of mathematics and the natural sciences.
	SSC 2	Be able to have sound knowledge of the core subjects of chemistry including inorganic, organic and physical chemistry, as well as of analytical chemistry.
	SSC 3	Be able to analyze subject's characteristics (content knowledge), students' characteristics and to select appropriate methods, models, approaches, strategies and media and to apply actively, innovatively, creatively in each educational unit.
	SSC 4	Be able to carry out practical chemistry work and have learnt how to handle chemicals independently and safely in the lab.
	SSC 5	Be able to have knowledge of safety and environmental issues and the legal fundamentals.
	SSC 6	Have gained methodological competence in chemistry education and are able to apply this in other contexts.

SSC (Subject-Specific Criteria)		
	SSC 7	Be able to obtain, interpret and evaluate data of scientific and technical relevance, and to draw sound conclusions, which take into account scientific, technological and ethical findings.
	SSC 8	Be able to solve problems of a scientific/application-oriented nature independently, and to present the results.
	SSC 9	Be able to pursue life-long learning.
	SSC 10	Be able to communicate with colleagues at the working field as well as with the broader public, about chemistry education-related contents and problems.
Social competences	**SSC 11**	Be aware of social and ethical responsibility in their actions and be able to develop appropriate leadership responsibility.
	SSC 12	Be able to work both alone and as a member of international, mixed-gender groups
	SSC 13	Be prepared for being in professional life and an academic environment, through adequate practical relevance of the degree programme.

The relevance between PLO and SSC is described below.

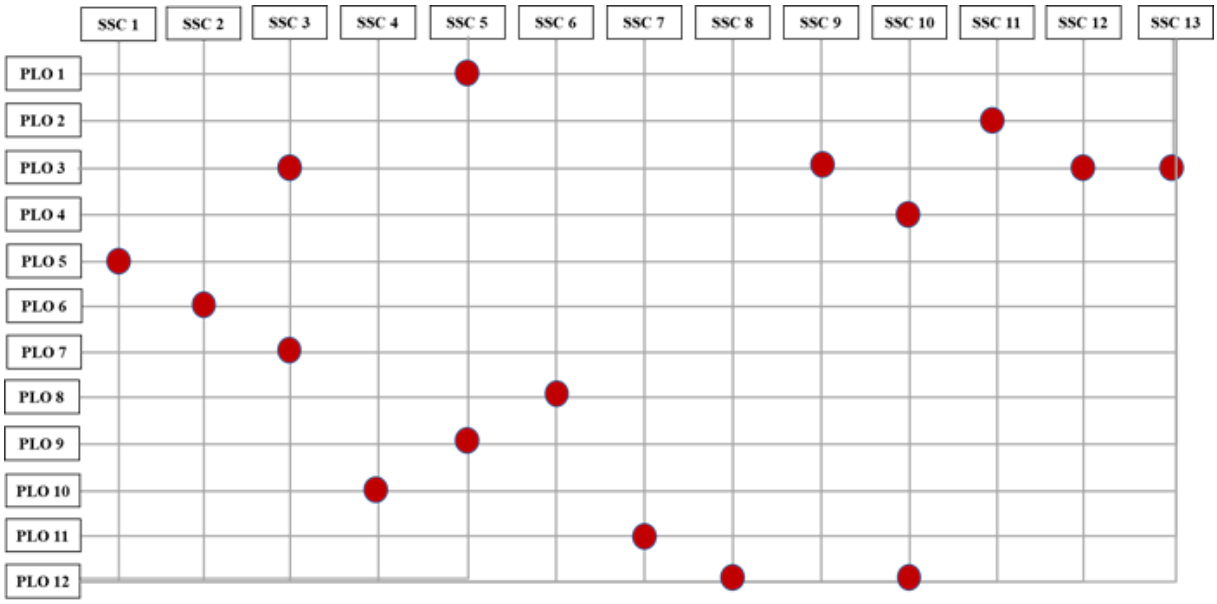

Figure 4 Mapping of PLO and SSC of bachelor's degree of Chemistry Study Program

D. PROGRAM STRUCTURE

The contents of curriculum in Chemistry study program are designed to realize the vision, mission, goals, and objectives of the Chemistry Study Program, Faculty of Mathematics and Natural Sciences, and the vision and mission of the UNJ. It is made to meet the expected outcomes, formulated based on input and intensive communication with stakeholders, such as industrial and governmental institutions, and has generated quality graduates.

The structure of curriculum has been designed and aligned with the Program Learning Outline (PLO). The details of curriculum structure mapping towards PLO attainment can be

seen in Table 5 There is a correlation to the expected competency for each course for the graduates, as given in the competency map (Figure 5). In the curriculum mapping, every course supports specific competencies.

The correlation among the branches in chemistry: physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry were fully formulated in designing this curriculum. Vertically, basic chemistry, physical chemistry, and analytical chemistry were given at the beginning of the study to create a good foundation for learning organic and inorganic chemistry courses. The courses related to the applied chemistry that is developing in the Chemistry study program are added in the optional courses. With this plan, the graduates are expected to apply chemistry in their job and be able to solve problems in other chemistry-related fields.

The curriculum of the programs has undergone several reviews. These reviews are conducted to ensure the compliance and relevance to the development of science, regulation of the university and professional associations, the suggestion from alumni and stakeholders, and job market requirement

The process of achieving the expected qualification profile is carried out through the main program lecture activities with a minimum number of 144 credits equivalent to 216 ECTS. Learning activities can be completed within eight semesters but no more than 14 semesters.

Curriculum structure The Chemistry study program consists of 5 groups of course (Group of General Courses or MKU, University and Faculty characteristic courses, Study Program features consist of Compulsory Courses and Elective Courses) and MBKM that must be completed during a minimum study period of 8 (eight) semesters and a maximum of 14 (fourteen) semesters with a credit unit range of 144 credits. Table 3 presents the curriculum and credits a bachelor's degree.

Table 3. Course structure in terms of obligations

No	Types of Courses	Total (In Credits)	Total (In ECTS)
1	University's Courses	14	21
2	Faculty's course	1	1.5
3	Compulsory Courses	105	157.5
4	Elective Course	4	6
5	Independent Learning Activities Course (MBKM)	20	30
Total		**144**	**216**

As mentioned above, to earn a B.Sc. degree in Chemistry, a candidate must pass at least 144 credit hours, consisting of compulsory and optional or elective courses, and write a final project (Thesis) based on research in chemistry. The compulsory courses (55 courses/120 credit hours) give general and basic competency for a chemistry bachelor's degree. The optional courses that are offered to the students consist of 24 courses including MBKM (overall 58 credit hours). The student can choose 18 credit hours from 58 credit hours offered. The elective courses give additional competency to the students. The elective courses are grouped into a more specific field of study. The final project has to be finished by research in the laboratory

and written in the final project report called undergraduate thesis (in Indonesian, this is called skripsi). The list of courses and their related competencies are given in Table 5 below.

The course distribution is hierarchically arranged, which illustrates that the courses of the semester above are an extension of courses from the previous semester. The distribution is based on the relationship between concepts, levels of knowledge, and course mapping that some of the upper semester courses have the preconditions in the previous semester. B.Sc. guarantees a balance between courses offered by the study program. The 8th-semester students no longer take theoretical courses but take thesis for six months. For this reason, students are expected to complete their degree in the 8th-semester.

The curriculum is developed through a series of processes from the body of knowledge up to curriculum structure (Table 4). The curriculum structure will guide students to achieve competencies that have been set and meet the PLO of Chemistry Program. Intended competencies that students can acquire after taking one course can be seen from the course module. Courses are designed from the core subject matter.

Table 4. Body of Knowledge of Chemistry Study Program

Code	Subject Matter	Descriptions	Course
SM1	Religion, character education, and behavioral science	To understand and resolve humanitarian and social problems based on religious beliefs related to education and social and community interactions.	1. Religion 2. Pancasila 3. Citizenship 4. Logic and Scientific Reasoning 5. Big Data and Programming 6. Introduction to Education 7. Olympism 8. Entrepreneurship
SM2	HSE (Health Safety Environment) laboratory and environmental education	To understand work safety, ethics, environmental issues, and policies related to the chemical field	1. HSE (Health, Safety Environment) laboratory 2. Environmental Education
SM3	Mathematics and Basic Science	To understand the basic principles of science and mathematics for solving various chemical problems	1. Basic Chemistry I 2. Basic Chemistry II 3. Practicum of Basic chemistry 4. Basic Physics 5. Practicum of Basic Physics 6. General Biology 7. Mathematical Chemistry
SM4	Scientific literacy and communication	To understand the analysis of research information and data (literacy) and communicate it to the	1. English 2. Indonesian 3. Chemistry Seminar

Code	Subject Matter	Descriptions	Course
		public orally and in writing, both scientifically and popularly	4. Pre-Thesis Seminar
SM5	Chemistry (organic chemistry, inorganic, analytical, physical, and Biochemistry)		1. Chemical Thermodynamics 2. Organic chemistry 3. Atomic Structure and Structure of Inorganic Compounds 4. Qualitative and Quantitative Chemical Analysis 5. Practicum of Qualitative and Quantitative Chemical Chemistry 6. Chemical Kinetics 7. Organic compound Reaction 8. Practicum of Organic chemistry 9. Basics of Inorganic Reactions 10. Structure and Function of Biomolecules 11. Separation Chemistry 12. Practicum of Physical chemistry 13. Biomolecular Metabolism 14. metal and non-metal chemistry 15. Practicum of Biochemistry 16. logic and scientific reasoning 17. Practicum of Instrumental Chemical Analysis & Separation 18. Quantum chemistry 19. Practicum of Inorganic chemistry 20. Transition Metals and Coordination Chemistry 21. Research Methodology & Statistics 22. Molecule Spectroscopy
SM6	Chemical instruments and analysis of data and information from these instruments	To understand the characterization technique with various spectroscopic tools and analyze the spectroscopic data for the elucidation of the structure of organic molecules /materials	1. Instrumental Chemical Analysis 2. Material characterization method 3. Molecular Structure Elucidation

Code	Subject Matter	Descriptions	Course
SM7	Bioscience & Material chemistry	To understand the applied science of organic, inorganic materials, and the structure of a chemical substance	1. Bioscience 2. Material chemistry
SM8	Internship, Final Project, Community Service Program	To understand the process towards professional life in academic, research, industrial and entrepreneurial environments that are relevant to the field of chemistry	1. Internship 2. Community Service Program
SM9	Thesis	To understand how to solve science and technology problems in the field of chemistry by applying relevant methods and technologies	Thesis

The curriculum structure mapping towards PLO of Chemistry Study Program is presented in table 5 below.

Table 5 Curriculum structure mapping towards PLO of Chemistry Study Program

Course code	Course Name	CP	ECTS	PLO											
				1	2	3	4	5	6	7	8	9	10	11	12
Semester 1															
00051142	Indonesian	2	3	v											
30050042	English	2	3.0				v								
00051122	Pancasila Education	2	3.0	v	v	v									
30051122	Olympism	1	1.5	v	v	v									
32251062	Basic Physics	2	3.0			v		v							
32251011	Practicum of Basic Physics	1	1.5			v		v					v		
34150013	General Biology	2	3.0			v		v							
33251083	Basic Chemistry 1	3	4.5			v		v							
33250152	Mathematical Chemistry	3	4.5			v		v							
33250332	Occupational Safety and Security Lab	2	4.5			v						v			
	Total CP	**21**	**31.5**												
Semester 2															
33250513	Basic Chemistry 2	3	4.5			v		v							
33250891	Practicum of Basic Chemistry	2	3.0			v		v					v		
33250671	Chemical Thermodynamics	3	4.5			v			v						
33250004	Organic chemistry	4	6.0			v			v						
30055053	Atomic Structure and Structure of Inorganic Compounds	3	4.5			v			v						
33250903	Environmental Education	2	3.0			v						v			
00052033	Religion	2	3.0	v											
00051112	Civic education	2	3.0	v	v	v									
	Total CP	**21**	**31.5**												
Semester 3															
33250933	Qualitative and Quantitative Chemical Analysis	3	4.5			v			v						
33250222	Practicum of Qualitative and Quantitative Chemical Chemistry	2	3.0			v			v				v		
33250263	Chemical Kinetics	3	4.5			v			v						
	Organic compound Reaction	4	6.0			v			v						
33250002	Practicum of Organic chemistry	2	3.0			v			v				v		

Course code	Course Name	CP	ECTS	PLO											
				1	2	3	4	5	6	7	8	9	10	11	12
33250803	Basics of Inorganic Reactions	2	3.0			v			v				v		
33250343	Structure and Function of Biomolecules	3	4.5			v			v						
00053222	Big data and programming	2	3.0	v	v	v									
	Total CP	**21**	**31.5**												
Semester 4															
33250233	Separation Chemistry	3	4.5			v			v						
33250001	Practicum of Physical chemistry	1	1.5			v			v				v		
33250393	Biomolecular Metabolism	3	4.5			v			v						
	metal and non-metal chemistry	2	3.0			v			v						
33250024	Bioscience	4	6.0			v				v					
33250054	Material chemistry	4	6.0			v				v					
33250132	Practicum of Biochemistry	2	3.0			v			v				v		
00053202	logic and scientific reasoning	2	3.0	v	v	v									
	Total CP	**21**	**31.5**												
Semester 5															
33250333	Instrumental Chemical Analysis	3	4.5			v					v			v	
33250292	Practicum of Instrumental Chemical Analysis & Separation	2	3.0			v					v		v		
33250093	Quantum chemistry	3	4.5			v			v						
33250153	Material characterization method	3	4.5			v					v			v	
33250103	Molecular Structure Elucidation	3	4.5			v					v			v	
33250162	Practicum of Inorganic chemistry	2	3.0			v			v				v		
33250133	Transition Metals and Coordination Chemistry	3	3.0			v			v						
	Total CP	**19**	**28.5**												
Semester 6															
33250003	Research Methodology & Statistics	3	4.5			v			v		v			v	v
33250632	Chemistry Seminar	2	3.0			v			v		v				
33250192	Entrepreneurship	2	3.0												
33250783	Molecule Spectroscopy	3	4.5			v			v						
00053182	Introduction to education	2	3.0	v	v										
	Total Elective courses	4	6			v			v		v	v	v	v	v
	Total CP	**18**	**27**												
Semester 7															
30052072	Pre-Thesis Seminar	2	3		v	v			v	v	v		v	v	v
	MBKM	20	33		v	v			v	v	v		v	v	v
	Total CP	**22**	**33**												
Semester 8															
30054024	Bachelor Thesis	4	6			v	V		v	v	v		v	v	v
	Total CP	**4**	6												
	Elective courses														
33250442	Secondary metabolite chemistry	2	3			v				v					
33251062	Food chemistry	2	3			v				v					
33250562	Polymer Chemistry	2	3			v				v					
33250462	Synthesis Organic Chemistry	2	3			v				v					
33250982	Biotechnology	2	3			v				v					
33250961	Environmental Chemistry Practicum	1	1.5			v				v					
33251053	Applied Electrochemistry	3	4.5			v				v					
33250742	Synthesis and Characterization of nanomaterials	2	3			v				v					
33251042	Determination of the structure of natural compounds	2	3			v					v	v			
33250362	Nanoscience and Nanomaterial	2	3			v				v					

Course code	Course Name	CP	ECTS	PLO											
				1	2	3	4	5	6	7	8	9	10	11	12
33250422	Surface Chemistry	2	3			v				v					
33250553	Microbiology	3	4.5			v				v					
33250412	Bioinorganic	2	3			v				v					
33250572	Solid Chemistry	2	3			v				v					
33250822	Industrial inorganic chemistry	2	3			v				v	v				
33251102	current issues organic chemistry	2	3			v				v					
33250872	Material Chemistry	2	3			v				v					
33251112	STEM (Science, Technology, Engineering, and Mathematics)	2	3			v				v			v	v	v
33250102	Capita Selecta chemistry	2	3			v				v					
33251022	Internship	2	3	v	v	v	v						v	v	v
KM-00292	Community Service Program	2	3	v	v	v	v	v	v	v	v	v	v	v	v
33250482	Chemistry learning	2	3												
33250492	chemical management	2	3			v						v			
33250322	industrial analytical chemistry	2	3			v				v					
MBKM (20 credits)															
Option 1 Research Internship															
KM-01001	Field practice	6	9		v	v				v	v	v	v	v	v
KM-01003	professional ethics	3	4.5		v	v									
KM-01003	Creativity and innovation	3	4.5		v	v									
KM-01002	Communication skills	2	3		v	v									
KM-00993	Problem solving and decision making	3	4.5		v	v									v
KM-01023	Information and digital literacy	3	4.5									v			v
Total		**20**	**30**												
Option 2 Industrial Internship															
KM-01001	Field practice	6	9		v	v	v			v	v	v	v	v	v
KM-01003	professional ethics	3	4.5		v	v	v								
KM-01003	Creativity and innovation	3	4.5		v	v	v								
KM-01002	Communication skills	2	3		v	v	v								
KM-00993	Problem solving and decision making	3	4.5		v	v	v						v	v	v
KM-01023	Information and digital literacy	3	4.5									v			v
Total		**20**	**30**												
Option 3 teaching assistant															
	Teaching Planning	3	4.5		v	v	v								
	Teaching methodology	4	6		v	v	v				v				v
	Teaching practice	6	9			v	v								v
	Evaluation of teaching activities	4	6			v	v								v
	Reports and Dissemination of Teaching Results	3	4.5			v	v				v				v
Total		**20**	**30**												
Option 4 Entrepreneurship															
	Social entrepreneurship	3	4.5		v	v									
	business ethics	2	3		v	v									v
	Introduction to Management and business	2	3		v	v									v
	Digital marketing	3	4.5	v	v	v									v
	Businessman: 1. Entrepreneurial design and presentation 2. business practice 3. Entrepreneurship activity report	10	15		v	v									v
Total		**20**	**30**												

Course code	Course Name	CP	ECTS	PLO											
				1	2	3	4	5	6	7	8	9	10	11	12
Option 5: Student Exchange **Option 6: Building a Village** **Option 7: Humanitarian Project** **Option 8: Independent Project**															
	Project Planning and Design	3	4.5	v	v				v	v	v	v	v	v	v
	Project Management	4	6	v	v										v
	Project implementation	6	9	v	v										v
	Project Data Analysis	4	6												v
	Report and Dissemination of Project Results	3	4.5												v
Total		**20**	**30**												

In Chemistry study program, students are required to complete 144-146 credit hours in courses that are provided by university, faculty, study program, and MBKM. The chemistry study program courses consist of compulsory courses of 105 credit hours give general and basic competency for a chemistry bachelor's degree. The elective courses that are offered to the students consist of 4 credit-hours in addition of 20 credit-hours of MBKM and 14 credit-hours of general courses. Elective courses are categorized into four interest groups which are Bioscience, Inorganic Chemistry, Physical Chemistry, and Analytical Chemistry. In Chemistry study program, the curriculum structure has been divided into 4 years program. First year focuses on basic knowledge of mathematics and natural science which consist and university cources of 42 credits courses. Second year of study focuses on chemistry spesific competences which consist of 42 credits courses. Third year focuses on chemistry and spesific competences in chemistry for a total 39 credits. Last year is consisted of 24 credits to be passed by students which focus on thesis and elective courses that support the thesis. Each course contributes to PLO in chemistry study program as figure 5.

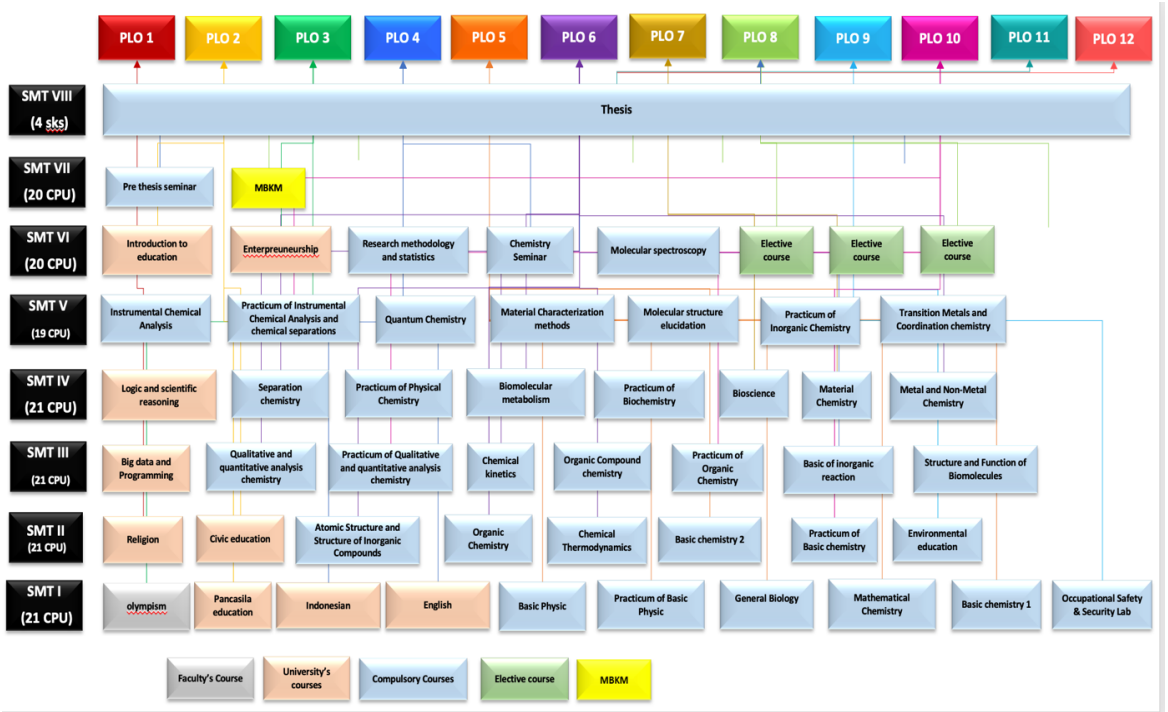

Figure 5 Course mapping based of Courses and PLO in Chemistry Study Program

Program Learning Outcome (PLO) and all courses' descriptions (module handbooks) from the Chemistry study program are available on the website (https://fmipa.unj.ac.id/kimia/).