CURRICULUM OF MERDEKA BELAJAR-KAMPUS MERDEKA 2020

Chemistry Study Program
Department of Chemical Education
Faculty of Mathematics and Natural Sciences
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CURRICULUM OF
MERDEKA BELAJAR - KAMPUS MERDEKA
2020
CHEMISTRY STUDY PROGRAM (S1)

FACULTY OF MATHEMATICS AND NATURAL SCIENCES UNIVERSITAS NEGERI YOGYAKARTA
2020

PREFACE

All praise and gratitude to Allah S.W.T who has given His abundance of grace and guidance so that the Chemistry Study Program curriculum development team can compile the 2020 Merdeka Belajar - Kampus Merdeka (MBKM) Curriculum. This curriculum is a development of the 2019 curriculum which was prepared as a follow-up to the Minister of Education and Culture's policy on MBKM as stated in Permendikbud Nomor 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi. The preparation of this curriculum also refers to Peraturan Presiden RI No. 8 Tahun 2012 tentang Kerangka Kualifikasi Nasional Indonesia (KKNI), Visions, Missions, and Objectives of UNY, Peraturan Rektor No 5 Tahun 2020 tentang Kurikulum MBKB Program Sarjana dan Sarjana Terapan Universitas Negeri Yogyakarta, also Peraturan Rektor No 7 Tahun 2020 tentang Panduan Implementasi Kurikulum MBKM Program Sarjana dan Sarjana Terapan Universitas Negeri Yogyakarta.

The MBKM policy provides an opportunity for students to 1 (one) semester or the equivalent of 20 (twenty) credits to take learning outside the study program at the same university; and a maximum of 2 (two) semesters or the equivalent of 40 (forty) credits to take learning in: (1) the same study program at a different HEI, (2) learning in different study programs at different HEIs; and/or (3) learning outside the HEI. Referring to this policy, the 2020 MBKM Curriculum of UNY Chemistry Study Program provides 3 (three) study period patterns that can be chosen by students, namely 5-1-2, 6-1-1, and 6-0-2. The three numbers successively indicate the number of semesters students study in their own study program, the number of semesters students have the opportunity to study in other study programs in the same university, and the number of semesters students have the opportunity to study in other study programs in different universities or outside universities.

The 2020 MBKM curriculum of Chemistry Study Program contains the vision, mission, objectives, graduate competencies, graduate profiles, list of main and specialization courses, distribution of courses for each semester according to three learning period patterns, and course descriptions. We hope that this curriculum will make a significant contribution in producing graduates who are professional, superior, creative, and innovative and highly competitive both at the national and international levels and provide convenience in the implementation of their education.

We would like to thank all those who have helped in the curriculum development process. There is no ivory that is not cracked, so also in the preparation of this curriculum. Therefore, we are looking forward to suggestions for the perfection of this curriculum.

Curriculum Development Team
Chemsitry Study Program

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INTRODUCTION

A. Background

One of the higher education tasks is to develop student competencies so that they have strong, skilled, creative, innovative, technopreneurship, and environmentally sensitive characters which are embodied in the curriculum. Undang-Undang No. 12 Tahun 2012 concerning Higher Education, has stated that the higher education curriculum is a set of plans and arrangements regarding the objectives, content, and teaching materials as well as the methods used as guidelines for the implementation of learning activities to achieve the goals of Higher Education. The curriculum changes is a natural process and should happen as stated by Oliva (2004) that "Curriculum change is inevitable and desirable". The development of science and technology, the needs of society, the progress of the era, and new government policies have led the curriculum to be changed.

The policy of Merdeka Belajar-Kampus Merdeka/MBKM (Freedom to Learn-Independent Campus) was taken by the government in response to the current rapid development of science and technology. These developments have brought a very rapid changes in various aspects of life, therefore universities must be able to prepare students to face the changes in social, cultural, world of work, and rapid technological advances. Student competencies must be prepared to be more responsive to the needs of the era. Link and match not only with the world of industry and the world of work but also with a rapidly changing future.

The Minister of Education and Culture through Permendikbud No. 3 Tahun 2020 concerning National Standards for Higher Education, has issued an MBKM policy which giving the opportunity for students to study outside their study program for 3 (three) semesters. Independent Campus is a learning form in higher education that is autonomous and flexible to create a learning culture that is innovative, unfettered, and in accordance with the students' needs. Through this program, there are wide opportunities for students to enrich and improve their insights and competencies in the real world in accordance with their passions and ambitions.

The Chemistry Study Program that graduates in the field of chemistry is required to design and implement innovative learning processes so that students can optimally achieve the learning outcomes including aspects of attitudes, knowledge, and skills. The learning design is recorded in the curriculum of the study program. Regarding the MBKM policy, the Chemistry Study Program finds the need to change the 2019 curriculum according to the applicable policies.

The development of curriculum is a complex, multidimensional, and multilevel process starting from the existing curriculum. The change in curriculum was carried out by the Chemistry Study Program refers to the MBKM policy and also refers to the Indonesian National Qualifications Framework/Kerangka Kualifikasi Nasional Indonesia (KKNI) in accordance with Peraturan Presiden RI Nomor 8 Tahun 2012. KKNI is a framework for leveling the qualification of competency to equalize and integrate the theory in educational fields toward practice in the field of job training and work experience, in order to provide recognition of work competencies in accordance with the work structure in various sectors. KKNI, which consists of nine levels, has implications for the higher education curriculum. Every university graduate, including UNY, must reach a certain level from the KKNI whis is level 6 for undergraduates.

The curriculum of the Chemistry Study Program also actualizes the vision, mission, and goals of Yogyakarta State University. UNY's vision is being a world-class educational university based on piety, independence and intelligence, which is superior, creative, innovative by 2025. In accordance with UNY's vision, the Faculty of Mathematics and Natural Sciences (FMIPA) sets the vision of "being a faculty of superior quality, in a scientific attitude, critical, creative, and innovative in the Southeast Asian region based on piety, independence, and intelligence in 2025. The vision, mission and goals of UNY are also actualized in the vision, mission and objectives of the Chemistry Study Program.

In addition to referring to the policies of the Minister of Education and Culture, KKNI, and the vision, mission and goals of UNY, curriculum development needs to be based on past, present, and future analysis of various dimensions of life. Similarly, based on the analysis of Strength, Weakness, Opportunity and Threat (SWOT) on the existing curriculum and the results of a tracer study on the performance of graduates. Furthermore, the study program needs to re-establish graduate profiles, learning outcomes (LO), courses and their weights, curriculum structure and semester programs, learning standards, and assessments. Curriculum improvement needs to be done systematically and comprehensively to cover university programs, faculties, majors and study programs.

B. Foundation of Curriculum Development

Curriculum of Merdeka Belajar – Kampus Merdeka at Chemistry Study Program Universitas Negeri Yogyakarta is an implementation of the Minister of Education and Culture policy . This curriculum is a mandate from various regulations/legal foundations of higher education in order to improve the quality of learning and higher education graduates. The legal basis for developing this curriculum are as follows:

1. Undang-undang Nomor 20 Tahun 2003 concerning Sistem Pendidikan Nasional
2. Undang-undang Nomor 14 Tahun 2005 concerning Guru dan Dosen
3. Undang-undang Nomor 12 tahun 2012 concerning Pendidikan Tinggi
4. Peraturan Presiden RI Nomor 8 Tahun 2012 concerning Kerangka Kualifikasi Nasional Indonesia (KKNI)
5. Peraturan Pemerintah Nomor 19 Tahun 2005 concerning Standar Nasional Pendidikan
6. Peraturan Pemerintah Nomor 74 Tahun 2008 concerning Guru
7. Peraturan Pemerintah Nomor 17 tahun 2010 concerning Pengelolaan dan Penyelenggaraan Pendidikan
8. Peraturan Menteri Pendidikan Nasional Nomor 16 Tahun 2007 concerning Standar Kualifikasi Akademik dan Kompetensi Guru
9. Peraturan Menteri Pendidikan Nasional Nomor 27 Tahun 2008 concerning Standar Kualifikasi Akademik dan Kompetensi Konselor
10. Peraturan Menteri Negara Pendayagunaan Aparatur Negara dan Reformasi Birokrasi Nomor 16 tahun 2009 concerning Jabatan Fungsional Guru dan Angka Kreditnya
11. Peraturan Menteri Ristekdikti Nomor 44 Tahun 2015 concerning Standar Nasional Pendidikan Tinggi (SNPT)
12. Peraturan Menteri Ristekdikti Nomor 35 Tahun 2017 concerning Statuta UNY
13. Peraturan Menteri Ristekdikti Nomor 55 Tahun 2017 concerning Standar Pendidikan Guru
14. Surat Edaran Dikti Nomor 255/B/SE/VIII/2016 tentang Panduan Penyusunan Kurikulum Pendidikan Tinggi
15. Peraturan Rektor UNY Nomor 1 Tahun 2019 concerning Peraturan Akademik UNY

16. Panduan Pengembangan Kurikulum Program Studi Universitas Negeri Yogyakarta Tahun 2019.
17. Peraturan Menteri Pendidikan dan Kebudayaan Nomor 3 Tahun 2020 concerning Standar Nasional Pendidikan Tinggi
18. Peraturan Rektor No 5 Tahun 2020 concerning Kurikulum Merdeka Belajar-Kampus Merdeka Program Sarjana dan Sarjana Terapan Universitas Negeri Yogyakarta
19. Peraturan Rektor No 7 Tahun 2020 concerning Panduan Implementasi Kurikulum Merdeka Belajar-Kampus Merdeka Program Sarjana dan Sarjana Terapan Universitas Negeri Yogyakarta

In addition, the development of curriculum at Chemistry Study Program is based on various philosophical foundations such as humanism, essentialism, perennialism, idealism, and social reconstructionism with the following thoughts:

1. Indonesian humans as God's creatures have a good divine nature; able to learn, and practice to acquire knowledge, skills, and form an intelligent, educated, and independent attitude.
2. Education builds Indonesian human being as Pancasilaists; devoted to God Almighty, humane, dignified, fair, democratic, and upholding social values.
3. Education equips students with progressive knowledge, skills, and attitudes to exist and succeed in their lives.
4. Education concerns the characteristics and needs of students, the needs of the community, the progress of science and technology, and Indonesian culture.
5. Educators have professional competencies including competencies in personality, social, pedagogical, and expertise in accordance with their scientific fields and work professionally and the principle of worship, *ing ngarso sung tuladha*, *ing madya mangun karsa*, dan *tut wuri handayani*.
6. An Educational institution is a system that is independent, authoritative, dignified, and responsible to enrich the life of the nation.

The development of curriculum at Chemistry Study Program is also based on a theoretical foundation, namely the following science and principles of curriculum development.

1. Based on existing curriculum models and concepts; curriculum development based on implemented curriculum;
2. Comprehensive; curriculum development is carried out comprehensively covering all aspects of curriculum, such as objectives, profiles, learning outcomes, teaching materials, courses (credit load, semester, and sequence), learning process, assessment process, internship activities, practicum, and goal achievement.
3. Sustainable; curriculum development is carried out sustainability. The study program curriculum development team conducts an ongoing curriculum evaluation and the results are used for further curriculum improvements;
4. Relevance; curriculum is developed in accordance with the progress of science and technology, the need of community, the need of the work world, and the progress of the era in terms of objectives, content, strategy, and evaluation.
5. Flexible; curriculum has horizontal and vertical flexibilities, kurikulum memiliki fleksibilitas horizontal dan vertikal, both in terms of content and implementation process in line to the characteristics of MBKM curriculum.
6. Systematic curriculum development follows procedures with clear steps by a competent development team.

C. Curriculum Development Stages

Chemistry Study Program curriculum development is based on the following curriculum development theories and principles.

1. Curriculum change is found as something that must happen because of the development of science, technology, art, and community culture
2. Curriculum development is based on the previous curriculum through a process of self-evaluation, tracer study, and in-depth futuristic studies.
3. Curriculum development is a non-individual team work involving lecturers, students, stakeholders, and other related elements.
4. The development of the study program curriculum is based on: (a) Kerangka Kualifikasi Nasional Indonesia, is abbreviated as KKNI, a framework for leveling the qualification of competency to equalize and integrate the theory in educational fields toward practice in the field of job training and work experience, in order to provide recognition of work competencies in accordance with the work structure in various sectors, (b) SN-DIKTI and (c) Merdeka Belajar-Kampus Merdeka policy
5. Development of undergraduate programs equivalent to KKNI level 6.

The procedure for developing the MBKM curriculum at the Chemistry Study Program was prepared regarding to Peraturan Rektor No. 7 of 2020 concerning Guidelines for the Implementation of the Independent Learning Curriculum-Free Campus for the Applied Undergraduate and Undergraduate Program, Yogyakarta State University. The curriculum development procedure includes the following steps:

1. Need analysis
2. Graduate profile determination
3. Formulation of main and additional learning outcomes (LO),
4. Determination of study materials,
5. Formation of Courses,
6. Credits load determination
7. Determination of courses organization and curriculum map/curriculum structure as time learning type of 5-1-2, 6-1-1, 6-0-2)
8. Implementation plan of MBKM program
9. Determination of learning activities, and
10. Determination of assessment system
11. Formulation of semester lesson plan/Rencana Pembelajaran Semester (RPS) for every course

These stages are shown in Figure 1.

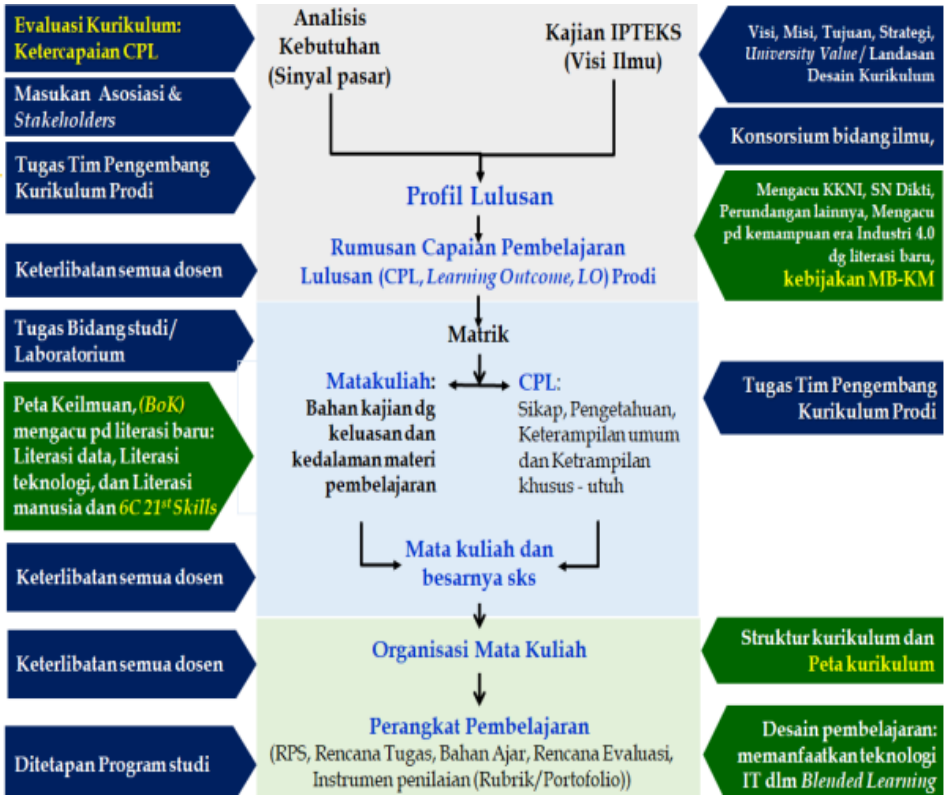

Figure 1. Formulation stages of curriculum documents

CURRICULUM OF STUDY PROGRAM

A. Vision and Mission

1. Vision of Study Program

The vision of the Chemistry Study Program of the Faculty of Mathematics and Natural Sciences UNY is "being a reputable study program at the Southeast Asian level in graduating chemists who are academically capable, professional, superior, creative, innovative and highly competitive in the field of chemistry based on piety, independence, and intelligence by 2025".

2. Misi Prodi

The mission of the Chemistry Study Program of the Faculty of Mathematics and Natural Sciences UNY is carrying out the Tri Dharma Perguruan Tinggi and other relevant activities including:

a) Education and teaching that can produce virtuous graduates having academic, professional, innovative, and creative abilities in the field of chemistry, are superior, independent, and highly competitive at the Southeast Asian level.
b) Chemical research that supports the development of chemical science and technology that is beneficial for increasing the dignity of human life and national development.
c) Community service through efforts to disseminate and apply the research results on the development of chemistry as well as participating in creating a scientific, democratic, and independent society to support national development.
d) Cooperation with local, regional, and international institutions to support the implementation of teaching, research, and chemical science development activities.
e) Fostering the academic community to become members of the campus community who are pious, independent, intellectual, and have a love for the nation, state, and nation

B. Graduate Profile

Graduate Profile of Chemistry Study Program, Universitas Negeri Yogyakarta Profil Lulusan Program Studi Kimia S1- FMIPA Universitas Negeri Yogyakarta is Sarjana Sains (S.Si.) in the field of chemistry who are superior, creative, innovative and highly competitive based on piety, independence, and intelligence. The expected profiles is as follows:

1. Main Profiles

a. **Chemical Analyst.** Chemistry Study Program graduates are with reliable abilities and skills to work as chemical analysts. These abilities and skills include: (1) mastery of theoretical concepts in the field of chemical analysis in depth, as well as being able to formulate solutions toward procedural problems in the field of chemical analysis and its application, (2) managerial mastery in applying chemical analysis tasks, including: sample preparation, method selection chemical analysis test, use of instruments, analytical data processing, laboratory preparation based on occupational safety and health (K3)

b. **Research Assistant in the field of chemistry working in industries, formal, and non-formal institutions**. Graduates of the Chemistry Study Program are equipped with reliable abilities and skills to work as research assistants, which include: (1) mastery of research concepts, procedures, and ethics in the field of chemistry, (2) management of research data for authentication purposes, originality in chemical studies , (3) ability to publish the analysis of research results, (4) ability to analyze the research results correctly.

c. **Laboratory Technician.** Graduates of the Chemistry Study Program are equipped with reliable abilities and skills to work as laboratory technicians. These abilities and skills include: (1) the ability to carry out supervisory activities in laboratory work, (2) utilize chemistry to solve problems and to adapt toward technological changes, (3) mastery of chemical testing, (4) skills in using instruments, (5) mastery of analytical skills and selection of appropriate methods and procedures for testing, (6) data processing and analysis, and (7) implementing occupational and environmental safety and health management.

d. **Continue to study at Master and Doctoral Programs.** Graduates of the Chemistry Study Program are equipped with reliable abilities and skills to continue their studies at higher levels of education.

2. Additional Profiles

a. **Trainer in the field of chemistry**

Graduates of the Chemistry Study Program are equipped with additional abilities and skills to become a trainer or communicator in the field of chemistry in educational institutions.

b. **Entrepreneur or Practitioner**.

Graduates of the Chemistry Study Program with mastery in the field of chemistry can develop themselves into entrepreneurs or practitioners. Additional skills such as managerial, accounting, entrepreneurial practice will support a career in entrepreneurship.

C. Program Learning Outcomes (PLOs)

Program Learning Outcome (PLOs) of Chemistry Study Program consists of Main PLO and Additional PLO.

1. Main PLOs

The main CPL is the ability obtained through the internalization of knowledge, attitudes, skills, competencies, and accumulated work experience (Perpres Nomor 8, 2012). The main PLOs of the Chemical Study Program is derived from a predetermined profile and refers to the PLO domain according to the KKNI. In general, this PLO is formulated in a concise manner in accordance with the provisions of ASIIN's international accreditation and certification agency into Program Learning Outcomes. The PLOs of the Chemistry Study Program is formulated in 10 PLOs (PLO1-PLO6) as listed in Table 1.

Table 1. Program Learning Outcomes of Chemistry Study Program

Domain	Program Learning Outcomes (ASIIN)		Sub PLO
Attitude	PLO1	Have a religious attitude and human values	A 1, 2, 3, 4 5, 6, 7, 8, 9, 10
Generic Skills	PLO2	Have an independent attitude, able to adapt, and be responsible in completing tasks	GS 2, 6, 7, 8
	PLO3	Have an ability to communicate ideas both in oral and writing	GS 1, 3, 4, 5, 9
Knowledge	PLO4	Have an ability in applying ICT effectively in their scientific field	K 5
	PLO5	Have an ability in using various strategies and techniques in chemical research to solve problems and chemical research	K 3, 4
	PLO6	Able to follow the development of science and technology as a support for lifelong learning	K 1
	PLO7	Have an ability to analyze chemical concepts and mindset oriented toward life skills	K 2
Specific skills	PLO8	Have an ability in applying chemistry to support productive and innovative behavior to solve problems in society	SS 1, 2
	PLO9	Have an ability to integrate mathematical and science concepts to solve problems in the filed of chemistry	SS 4, 5
	PLO10	Have an ability to innovate in chemical research technique	SS 3

The formulation of main PLOs refers to Peraturan Menteri Pendidikan dan Kebudayaan RI nomor 73 tahun 2013 concerning KKNI and Permendikbud No 3 Tahun 2020 concerning Standar Nasional Pendidikan Tinggi that covering the competency of attitude, knowledge, general skills and specific skills elaborated from PLO formulation recommended by Himpunan Kimia Indonesia (HKI). The main PLOs are fulfilled through the achievement of distributed study materials in the main courses of the Chemistry Study Program.

Sub mail PLO of Chemistry Study Program Universitas Negeri Yogyakarta are listed in Table 2.

Tabel 2. Sub PLOs of Chemistry Studi Program

LO Domain	Sub PLOs of Chemistry Studi Program
Attitude	C 1.1 believing in the God Almighty and able to show religious attitude;
	C 1.2 upholding human values in carrying out tasks based on religion, morals, and ethics;
	C 1.3 contribute to improving the quality of life in society, nation, state, and the advancement of civilization based on Pancasila;
	C 1.4 playing a role as a citizen who is proud and loves the country, has nationalism and a sense of responsibility to the state and nation;
	C 1.5 respecting the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;

LO Domain	Sub PLOs of Chemistry Studi Program
	C 1.6 having ability to work together and have social sensitivity and concern for society and the environment;
	C 1.7 law-abiding and disciplined in social and state life state;
	C 1.8 internalizing academic values, norms, and ethics;
	C 1.9 demonstrating an attitude of responsibility for work in their field of expertise independently; and
	C 1. 10 internalizing the spirit of independence, struggle, and entrepreneurship.
Knowledge	C 2.1 Able to use basic concepts of physics, biology, chemistry and mathematics to innovate in solving chemical problems;
	C 2.2 Able to master concepts, principles and skills in the field of chemistry which includes structure, dynamics, energetics, and measurement in depth which is oriented towards life skills;
	C 2.3 Able to master knowledge in the field of chemistry related to the process of identification, isolation, characterization, transformation, and synthesis of micromolecular chemicals and their applications to make alternative solutions in solving problems in everyday life;
	C 2.4 Able to master the principles of K3 (Occupational Safety and Security), laboratory management and the use of equipment and how to operate chemical instruments, as well as data analysis from these instruments; and
	C 2.5 Able to master the basics of scientific methods and the principles of using Information and Communication Technology (ICT) for the purposes of storage, evaluation, analysis, process, and data collection in the fields of chemistry, research, and industry.
Generic Skills	C 3.1 able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with his/her field of expertise;
	C 3.2 able to demonstrate independent, quality, and measurable performance;
	C 3.3 able to examine the implications of the development or implementation of science and technology that pay attention to and apply humanities values in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs or art criticism;
	C 3.4 able to compile a scientific description of the results of the study above in the form of a thesis or final project report, and upload it on the university website;
	C 3.5 able to make decisions appropriately in the context of problem solving in their field of expertise, based on the results of information and data analysis;
	C 3.6 able to maintain and develop work networks with supervisors, colleagues, peers both inside and outside the institution;
	C 3.7 able to be responsible for the achievement of group work results and to supervise and evaluate the completion of work assigned to workers under his/her responsibility;

LO Domain	Sub PLOs of Chemistry Studi Program
	C 3.8 able to carry out a self-evaluation process of the work group under his responsibility, and able to manage learning independently; and
	C 3.9 able to document, store, secure, and retrieve data to ensure validity and prevent plagiarism.
Specific Skills	C 4.1 Able to perform general and specific laboratory work, as well as synthesis and measurement techniques
	C 4.2 Able to systematically analyze various alternative solutions related to identification, analysis, isolation, transformation, and synthesis of simple chemicals
	C 4.3 Able to solve science and technology problems in the field of chemistry by applying relevant methods and technologies
	C 4.4 Able to use software to process and analyze chemical experimental data and to determine the structure, properties, and behavior of simple molecules
	C 4.5 Able to utilize Big Data, Internet of Things (IoT), Artificial Intelligence (AI) for problem solving in the field of Chemistry

2. Additional PLOs

Additional PLO is an additional learning achievement that includes aspects of knowledge and skills to enrich the competencies of graduates of the Chemistry Study Program to compete in the world of work in accordance with the graduate profile as shown in Table 3. Additional PLOs relevant with characteristics of Merdeka Belajar- Kampus Merdeka (MBKM) curriculum based on Peraturan Rektor UNY Nomor 7 Tahun 2020.

Table 3. PLOs in accordance to Graduate Profile

Graduate Profile	Additional PLOs
Trainer in the field of chemistry	Able to master effective communication skills. In addition, it strongly supports knowledge in the field of chemistry learning, such as curriculum development and chemistry learning, chemistry learning strategies, media and chemistry learning resources
Entrepreneur or practitioner	a. Able to master minimal theoretical concepts in the field of entrepreneurship/entrepreneurship such as management, accounting, marketing strategies. b. have knowledge of industrial management, especially the chemical industry in a safe, efficient and effective manner. c. Have skills in entrepreneurial practice

D. Study Materials

According to Undang-Undang No. 20 Tahun 2003, Article 1, Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potency to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and state. The national education goals are in line with the Vision and Mission of UNY, FMIPA, and the Chemistry Study Program.

In addition to referring on KKNI and SN-Dikti, MBKM curriculum of Chemistry Study Program is formulated based on Peraturan Rektor Universitas Negeri Yogyakarta Nomor 7 Tahun 2020 concerning Panduan Implementasi Kurikulum Merdeka Belajar-Kampus Merdeka Program Sarjana dan Sarjana terapan Universitas Negeri Yogyakarta, Buku Panduan Merdeka Belajar-Kampus Merdeka.

SWOT (Strength, Weakness, Opportunity and Threat) analysis has been carried out by the Chemistry Study Program on the quality of Human Resources, environmental and Natural Resources, job market, stakeholders, implementation of learning, implementation of research, development and achievement of student affairs, partnerships and collaborations, financial support and financial administration, availability of institutional facilities and infrastructure, technological advancements in the digital era, as well as institutional branding, the UNY Chemistry Study Program sets Study Materials courses with a focus on excellence (a) Indonesia's natural resource-based chemistry, (b) green and global chemistry, (c) spiritual/religious chemistry, (d) cultural chemistry, and (e) chemistry in the digital era and the industrial revolution.

Study materials in courses at Chemistry Study Program are developed by the curriculum team to refer to the focus of excellence of the Chemistry Study Program and the PLOs of the Chemistry Study Program mentioned above. Based on the study materials mapping, Chemistry Study Program courses were developed. Study materials according to PLOs can be seen in Table 4.

Table 4. Study Materials for PLOs

Domain	Main PLOs	Study Materials	Code
Attitude (A)	1. believing in the God Almighty and able to show religious attitude religious;	Piety and religious attitude according to his/her religion	SMA-101
	2. upholding human values in carrying out tasks based on religion, morals, and ethics;	Humanitarian concepts and values	SMA-201
	3. contribute to improving the quality of life in society, nation, state, and the advancement of civilization based on Pancasila;	Pancasila as the foundation in the life of society, nation and state	SMA-301

Domain	Main PLOs	Study Materials	Code
	4. playing a role as a citizen who is proud and loves the country, has nationalism and a sense of responsibility to the state and nation;	Citizenship	SMA-401
	5. respecting the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;	Cultural diversity	SMA-501
		Diversity appreciation	SMA-502
	6. having ability to work together and have social sensitivity and concern for society and the environment;	Social sensitivity and concern for society and the environment	SMA-601
		Working together	SMA-602
	7. law-abiding and disciplined in social and state life state;	Law-abiding	SMA-701
		Discipline	SMA-702
	8. internalizing academic values, norms, and ethics;	Academic values and norms	SMA-801
		Academic ethics	SMA-802
	9. demonstrating an attitude of responsibility for work in their field of expertise independently; and	Self-reliance attitude	SMA-901
		Responsible attitude	SMA-902
	10. internalizing the spirit of independence, struggle, and entrepreneurship	Entrepreneurial spirit	SMA-1001
		Hard work attitude	SMA-1002
Knowledge (K)	1. able to use basic concepts of physics, biology, chemistry and mathematics to innovate in solving chemical problems;	Basic mathematical concepts	SMK-101
		Basic concepts of science and their applications in chemistry	SMK-102
		Computer simulation to calculate the properties of molecules and macromolecules and their changes	SMK-103
	2. able to master concepts, principles and skills in the field of chemistry which includes structure, dynamics, energetics, and measurement in depth	Dynamics and Energetics of chemical processes	SMK-201
		Structure, dynamics, energetics, and characterization of organic compounds	SMK-202
		Structure, dynamics, energetics, and	SMK-203

Domain	Main PLOs	Study Materials	Code
	which is oriented towards life skills;	characterization of inorganic compounds	
		Analyze the composition and structure of substances	SMK-204
		Physical properties and energy in chemical processes	SMK-205
		Properties, processes, activities, chemistry in living cells (organisms)	SMK-206
		Development of advanced and environmentally friendly materials	SMK-207
		Separation of mixtures	SMK-208
	3. able to master knowledge in the field of chemistry related to the process of identification, isolation, characterization, transformation, and synthesis of macromolecular chemicals and their applications to make alternative solutions in solving problems in everyday life;	Process, synthesis, and characterization of organic compounds	SMK-301
		Process, synthesis, and characterization of inorganic compounds	SMK-302
		Isolation of organic compounds and natural materials	SMK-303
		Organic structure elucidation	SMK-304
		Inorganic structure elucidation	SMK-305
		Chemical research trends	SMK-306
		Computational chemistry for compound design, characterization, and modification	SMK-307
		Relevance of chemistry research and society	SMK-308
	4. able to master the principles of K3 (Occupational Safety and Security), laboratory management and the use of equipment and how to operate chemical instruments, as well as data analysis from these instruments; and	Principles of occupational safety and security	SMK-401
		Chemistry laboratory management	SMK-402
		Chemistry laboratory procedures	SMK-403
		Operation of instruments for chemical research	SMK-404
		Environmental issues and their handling	SMK-405
	5. able to master the basics of scientific methods and the principles of using Information and Communication	Basic concepts of the scientific method	SMK-501
		Scientific Communication	SMK-502
		Research Ethics	SMK-503
		Publication Ethics	SMK-504

Domain	Main PLOs	Study Materials	Code
	Technology (ICT) for the purposes of storage, evaluation, analysis, process, and data collection in the fields of chemistry, research, and industry.	Principles of Information and Communication Technology	SMK-505
		Copyright appreciation	SMK-506
Generic Skills (GS)	1. able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that pays attention to and applies humanities values in accordance with his/her field of expertise;	Implementation of appropriate technology to solve problems	SMGS-101
		Implementation of scientific thinking skills in solving problems	SMGS -102
		Implementation of knowledge to solve problems	SMGS -103
	2. able to demonstrate independent, quality, and measurable performance;	Preparation of assignments in the form of portfolios, reports, articles or projects independently	SMGS -201
	3. able to examine the implications of the development or implementation of science and technology that pay attention to and apply humanities values in accordance with their expertise based on scientific rules, procedures and ethics in order to produce solutions, ideas, designs or art criticism;	Presentation of ideas resulting from studies on the development of science and knowledge	SMGS -301
		Presentation of ideas resulting from the study of the implications of science and knowledge	SMGS -302
	4. able to compile a scientific description of the results of the study above in the form of a thesis or final project report, and upload it on the university website;	Writing the final thesis project in chemistry	SMGS -401
	5. able to make decisions appropriately in the context of	Make decisions related to problem solving solutions in the field of chemistry	SMGS -501

Domain	Main PLOs	Study Materials	Code
	problem solving in their field of expertise, based on the results of information and data analysis;	Mengambil keputusan terkait solusi pemecahan masalah lingkungan	SMGS -502
	6. able to maintain and develop work networks with supervisors, colleagues, peers both inside and outside the institution;	Internship	SMGS -601
		Sampling and data collection	SMGS -602
		Research permission in the field	SMGS -603
		Participation in community activities and development	SMGS -604
		Develop collaboration skills with others both in the work environment and in the community	SMGS -605
	7. able to be responsible for the achievement of group work results and to supervise and evaluate the completion of work assigned to workers under his/her responsibility;	Reflecting on shared performance achievements	SMGS -701
		Laboratory management	SMGS -702
		Research management	SMGS -703
	8. able to carry out a self-evaluation process of the work group under his responsibility, and able to manage learning independently; and	Self-directed learning management	SMGS -801
		Reflecting on the achievement of self-competence	SMGS -802
	9. able to document, store, secure, and retrieve data to ensure validity and prevent plagiarism.	Organization of scientific data collection results	SMGS -901
		Writing scientific papers based on valid data	SMGS -902
		Application of scientific publication ethics	SMGS -903
Specific Skills (SS)	1. able to perform general and specific laboratory work, as well as synthesis and measurement techniques	Planning laboratory activities	SMSS -101
		Management of laboratory activities	SMSS -102
		Implementation of laboratory activities	SMSS -103
		Evaluation of practicum activities	SMSS -104
		Analyze the results of practicum activities	SMSS -105
	2. able to systematically analyze various alternative solutions	Designing chemical research	SMSS -201
		Chemical compound modification	SMSS -202

Domain	Main PLOs	Study Materials	Code
	related to identification, analysis, isolation, transformation, and synthesis of simple chemicals	Process and synthesis of chemical compounds	SMSS -203
		Identification and characterization of chemical compound synthesis results	SMSS -204
		Chemical compound modeling	SMSS -205
	3. able to solve science and technology problems in the field of chemistry by applying relevant methods and technologies	Analyze science and technology problems in chemistry	SMSS -301
		Design of solutions to science and technology problems in the field of chemistry	SMSS -302
		Implementation of research to solve science and technology problems in the field of chemistry	SMSS -303
		Report the research result based on valid research results	SMSS -304
	4. able to use software to process and analyze chemical experimental data and to determine the structure, properties, and behavior of simple molecules	Use of software for chemical experiment data analysis	SMSS -401
		Software applications for simple molecular modeling	SMSS -402
		Use of software for research writing and publication	SMSS -403
	5. able to utilize Big Data, Internet of Things (IoT), Artificial Intelligence (AI) for problem solving in the field of Chemistry	Computational chemistry for problem solving in chemistry	SMSS -501
		Big Data application of crystal structure of chemical compounds	SMSS -502
		Big Data application for chemical material characterization	SMSS -503
		IoT to solve chemical problems	SMSS -504

Based on the mapping of the study materials, the course was developed. In line with the concept of MBKM curriculum, the courses are categorized into 3 (three) groups, namely:

a. **Main Courses/Mata Kuliah Utama (MKU)**. This courses are aimed at fulfilling the mail PLOs in the Chemistry Study Program, which based on their characteristics are divided into 4 (four) groups, i.e.

1) University Courses/Mata Kuliah University (MKU)

Are courses at university level to develop character and nationality, also to achieve the university's vision and mission.

2) **Fakulter Courses/Mata Kuliah Fakulter (MKF)**
   Are courses as faculty characteristic to develop generic knowledge in the faculty level.
3) **Study Program Courses/Mata Kuliah Program Studi (MKPS)**
   Are expertise courses in the field of chemistry developed by the Chemistry Study Program to develop student competencies in chemistry. **Study Program courses can be taken outside of UNY with a credit transfer scheme.**
4) **Study Program Courses/Mata Kuliah Program Studi (MKPS) that carried out outside university**
   consist of Internship/Praktik Kerja Lapangan (PKL), Community Service, and Thesis

b. **Additional Courses or Specialization Courses**
   Are courses to support main PLOs achievement, consist of advanced courses and excellent/characteristic/specialization of study program's courses. **Additional or specialization courses can be taken outside of UNY with a credit transfer scheme.**
c. **Outside Study Program Courses/Mata Kuliah Luar Program Studi**.
   Are elective courses chosen by students to fulfill the main PLOs which are taken outside study programs or outside university.

The relationship between the courses and study materials can be seen in Table 4, while Table 5 presents a description of the additional courses implemented as independent learning activities. Procedures for taking additional courses as independent learning activities are set out in separate guidelines from this curriculum.

Tabel 5. Relationship between Courses and Study Materials

No	Courses	Study Materials			
		Study Materials of Attitude (SMA)	Study Materials of Knowledge (SMK)	Study Materials of Generic Skills (SMGS)	Study Materials of Specific Skills (SMSS)
MAIN COURSES/MATA KULIAH UTAMA					
University Courses/Mata Kuliah Universitas (MKU)					
1	Islamic Education*	101,201,901, 902		201, 801, 802	
	Catholic Education*	101,201,901, 902		201, 801, 802	
	Christian Education*	101,201,901, 902		201, 801, 802	
	Buddhist Education*	101,201,901, 902		201, 801, 802	
	Hinduism Education*	101,201,901, 902		201, 801, 802	
	Confucianism Education*	101,201,901, 902		201, 801, 802	
2	Civic Education	201,301,401, 501,601,701, 801		101, 201, 301, 302,	

No	Courses	Study Materials			
		Study Materials of Attitude (SMA)	Study Materials of Knowledge (SMK)	Study Materials of Generic Skills (SMGS)	Study Materials of Specific Skills (SMSS)
				605, 801, 802	
3	Pancasila	201,301,401, 501,601,701		101, 201, 301, 302, 801, 802	
4	Bahasa Indonesia	401,604,801, 901,902	502	201,401, 801, 802, 902	
5	English	801,901,902	502	201, 801, 802	
6	Digital Transformation	201,801,901, 902	505,506	101, 201, 301, 302, 801, 802	301,401,402,403504
7	Creativity, Innovation and Entrepreneurship	901,902,10011002	308,506	201, 301, 302, 605, 801, 802	301
8	Social Literacy and Humanity	201,601,801		101,201, 301, 302, 605, 801, 802	301
Faculty Courses/Mata Kuliah Fakulter (MKF)					
9	Study of Mathematics and Natural Sciences	601,602,801, 802,901,902	102,306,308, 501	201,301,302, 605,801,802	301,401
10	Statistics	802,901	101,501	201,301,605, 801,802	301,401
Study Program Courses/Mata Kuliah Program Studi (MKPS)					
11	General Chemistry	801,802,901	102,201-207, 306,401	201,801, 802	101,103,105,201301,401
12	Physics for Chemistry	801,802,901	102,205	201,801,802	
13	Mathematics for Chemistry	801,802,901	101,205	201,801,802	
14	Chemical equilibrium	801,802,901	101,102,201, 205,401	201,801,802	101,103,105,201301
15	Molecular Dynamics	801,802,901	101,102,201, 205,401	201,801,802	101,103,105,205301,402
16	Fundamentals of Organic Chemistry	801,802,901	102,202,301, 304,401	201,801,802	101,103,105,205301

No	Courses	Study Materials			
		Study Materials of Attitude (SMA)	Study Materials of Knowledge (SMK)	Study Materials of Generic Skills (SMGS)	Study Materials of Specific Skills (SMSS)
17	Structure and Reactivity of Organic Compounds	801,802,901	102,202,301, 304,401	201,801,802	101,103,105,20 2203,205,301
18	Non-metal Inorganic Chemistry	801,802,901	101,102,203, 205,302,401	201,801,802	101,103,105,20 2203,205,301
19	Metal Inorganic Chemistry	801,802,901	101,102,203, 205,302,401	201,801,802	101,103,105,20 2203,205,301
20	Fundamentals of Analytical Chemistry	801,802,901	101,102,204, 401	201,801,802	101,103,105,20 2203,301
21	Chemical Separation Method	801,802,901	101,102,204, 208,401	201,801,802	101,103,105,20 2203,301
22	Biochemistry	801,802,901	102,206,401	201,801,802	101,103,105,20 2203,205,301
23	Nuclear Chemistry	801,802,901	102	201,801,802	201,301
24	Environmental Chemistry	601,801,802, 901	102,207,405	201,502,801 802	201,301
25	Quantum Chemistry	801,802,901	101,102,201, 307	201,801,802	203,402
26	Atomic and Molecular Spectroscopy	801,802,901	101,102,201, 205,401	201,801,802	101,103,105,20 5301,402
27	Colloidal and Surface Chemistry	801,802,901	102,207,306	201,801,802	202,301
28	Polymer chemistry	801,802,901	102,207,306	201,801,802	202,301
29	Physical Organic Chemistry	801,802,901	102,202,301	201,801,802	301,401
30	Determination of the structure of Organic Compounds	801,802,901	202,304	201,801,802	105,204,301,40 1
31	Natural Products Chemistry	801,802,901	202,303	201,801,802	202,301,402
32	Coordination Chemistry	801,802,901	101,102,203, 205,302,401	201,801,802	101,103,105,20 2203,205,301
33	Crystallochemistry	801,802,901	103,203,305	201,801,802	204,401
34	Chemical Instrumentation	801,802,901	204,301,404	201,801,802	105,201,401

No	Courses	Study Materials			
		Study Materials of Attitude (SMA)	Study Materials of Knowledge (SMK)	Study Materials of Generic Skills (SMGS)	Study Materials of Specific Skills (SMSS)
35	Chemical Laboratory Management	801,802,901	402	201,702, 801,802	102
36	Physical Biochemistry	801,802,901	102,206,401	201,801,802	101,103,105,202203,205,301
37	Fundamental of Computational Chemistry	801,802,901	101,102,103, 307	201,501,801 ,802	205,402,501
38	Advanced of Computational Chemistry	801,802,901	101,102,103, 307	201,501,801 ,802	205,402,501
39	Selected Chemistry Research Topics	801,802,901	102,306,308, 506	201,401,501 , 801, 802, 901, 902,903	201,301
40	Chemical Research Methodology	801,802,901	102,306,308, 401,501,506	201,401,501 , 602,801,802 , 901,902,903	101,201,301,401
Program Study Specialization Course of Renewable and Functional Chemistry Materials					
41	Chemical Application of Theory Group	801,802,901	101,102,203	201,801,802	205,301,501
42	Inorganic Chemical Synthesis	801,802,901	102,203,302, 401	201, 801, 802	103,202,301
43	Solid Inorganic Chemistry	801,802,901	102,203,302	201, 801, 802	202,301
44	Structural Analysis of Inorganic Compounds	801,802,901	203,302, 305	201, 801, 802	105,204,402
45	Nanochemistry Technology	801,802,901	102,203,302	201, 801, 802	202,301
46	Bioinorganic	801,802,901	102,203,302	201, 801, 802	202,301
47	Organometal	801,802,901	102,203,302	201, 801, 802	202,301
48	Material Chemistry	801,802,901	102,203,207, 302	201, 801, 802	202,301
49	Membrane Technology	801,802,901	102,203,302	201, 801, 802	202,301

No	Courses	Study Materials			
		Study Materials of Attitude (SMA)	Study Materials of Knowledge (SMK)	Study Materials of Generic Skills (SMGS)	Study Materials of Specific Skills (SMSS)
50	Catalyst Chemistry	801,802,901	102,203,207, 302	201, 801, 802	202,301
51	Geochemistry	801,802,901	102,203,302	201, 801, 802	202,301
Program Study Specialization Course of Biological Chemistry					
52	Pharmaceutical chemistry	801,802,901	102,301	201, 801, 802	202,301
53	Molecular Biotechnology	801,802,901	102,301	201, 801, 802	202,301
54	Food Chemistry	801,802,901	102,301	201, 801, 802	202,301
55	Synthetic of Organic Chemistry	801,802,901	102,202,301	201, 801, 802	103,202,301
56	Isolation and Identification of Natural Material Compounds	801,802,901	303	201, 801, 802	101,102,204,301
57	Structural Analysis of Inorganic Compounds	801,802,901	102,202,301, 304	201,801,802	202,205,301
58	Toxicology	801,802,901	102,301	201, 801, 802	202,301
59	Enzymology	801,802,901	102,301	201, 801, 802	202,301
60	Petroleum Chemistry and Energy	801,802,901	102,203,207, 302	201, 801, 802	202,301
61	Fermentation Technology	801,802,901	102,301	201, 801, 802	202,301
62	Medicinal Chemistry	801,802,901	102,301	201, 801, 802	202,301
Program Study Specialization Course of Environmental Friendly Chemistry					
63	Electrochemical Analysis	801,802,901	204,306	201, 801, 802	202,301
64	Corrosion and Electroplating Chemistry	801,802,901	102,306	201, 801, 802	202,301
65	Radioanalysis	801,802,901	102,204	201,801,802	201,301
66	Management of hazardous wastes and toxic	601,801,802, 901	102,207,405	201,502,801 802	201,301
67	Surfactants and Additives	801,802,901	102,306	201,801,802	202,301
Program Study Specialization Course of Industrial Chemistry and Enterpreunership					
68	Industrial Materials Analysis	801,802,901	102,306	201,801,802	202,301
69	Chemical Industry	801,802,901	102,201,306	201,801,802	202,301

No	Courses	Study Materials			
		Study Materials of Attitude (SMA)	Study Materials of Knowledge (SMK)	Study Materials of Generic Skills (SMGS)	Study Materials of Specific Skills (SMSS)
70	Industrial Management	801,802,901	401,403	201,501,702 801, 802	202,301
71	Entrepreneurial Practice	801,802,901 1001,1002	308	201,501,605 , 701,801, 802	301
72	Industrial Internship	801,802,901	102,201,306, 401,501	201,501,601 , 702,801,802 , 901,902	101,102,103,20 1301,401
Compulsory Outside Study Program Course					
73	Internship	801,802,901	102,201,306, 401,501	201,501,601 , 702,801,802 , 901,902	101,102,103,20 1301,401
74	Community Service	201,302,401, 502,601,701, 901,902,100 11002	207,405	102, 103, 201, 301, 302, 501, 604, 605, 701, 801, 802	301
75	Thesis	801,901,902, 1002	102,201.306, 308,401,501, 502,503	201,401,501 , 603,605,801 , 802,901,902	103,105,201,30 1 401, 402, 503

Table 6. Description of learning freedom activities in Chemistry Study Program

Freedom of Learning Activity	No	Form of Activity	Status	Description
Industrial Internship	1	Internship in industry	Elective	Intership activity in company to practice the knowledge related to chemistry
Project in Village	2	Project activity in village	Elective	Activity to do a project in a village to practice the knowledge related to chemistry
Students' Exchange	3	Study Program Courses or Outside Study Program Courses	Compulsory for learning systems of 6-1-1 & 5-1-2	a. The Course group is taken outside the study program. b. Courses are elected in line with students' specialization c. Course code follows course code in the destination study program

Freedom of Learning Activity	No	Form of Activity	Status	Description
				d. Courses achievement can be converted from other freedom of learning activities, instead of credit transfer programs.
	4	Specialization Courses	Elective	a. Additional courses outside the study program taken outside the university specifically for the 6-1-1 study pattern b. The course code follows the course code in the destination study program
	5	Outside University Course	Compulsory for learning pattern of 6-0-2	a. Courses group taken outside the study program outside the university. b. Courses are elected in line with students' specialization c. The course code follows the course code in the destination study program d. Courses achievement can be converted from other freedom of learning activities, instead of credit transfer program and outside study program courses
	6	Credit transfer	Elective	Courses taken outside the study program to replace the original study program courses
Research	7	Chemistry Research Internship Outside Study Program	Elective	Research internships in chemistry outside the study program to develop research experience and not a substitute for chemical research courses as the original study program course
	8	Chemistry Research Internship Outside University	Elective	Research internship in chemistry outside the university to develop research experience and not as part of research for the final thesis
	9	Research Internship	Elective	Research internship activities other than the field of chemistry carried out outside the study program in order to develop student specialization
Entrepreneurship activity	10	Entrepreneurial Practice	Elective	Internship activities carried out in Small and Medium Enterprises to directly study the planning, management, marketing and

Freedom of Learning Activity	No	Form of Activity	Status	Description
				evaluation of business activities or independent entrepreneurial pilot activities either through funding programs from universities, other agencies or their own costs
Independent Study/Project Studi/Proyek independent	11	Independent Project Activities	Elective	Students' independent study/project activities to produce individual or group works that can be entered in national competitions through funding of the freedom to learn program
Humanitarian project	12	Humanitarian Social Activities	Elective	Activities related to humanitarian social action in certain programs such as involvement in disaster management teams, public health programs, and programs for disadvantaged communities
Teaching in School	13	Teaching Practices in School	Elective	Teaching practice activities carried out by students to develop their experience, talents and interests, especially teaching literacy and numeracy in elementary or junior high schools, teaching in vocational training centers or in community learning centers

Furthermore, to clarify the support of study program courses to the achievement of PLOs, the relationship matrix is presented in Table 7.

Table 7. Relationship matrix between Courses and Study Program's PLOs

No	Courses	PLO1	PLO2	PLO3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0
		Sub-PLO Attitude (A)	Sub-PLO Generic Skills (GS)		Sub-PLO Knowledge (K)				Sub-PLO Specific Skills (SS)		
1	Islamic Education*	A1, A2, A9	GS2, GS8								
	Catholic Education*	A1, A2, A9	GS2, GS8								
	Christian Education*	A1, A2, A9	GS2, GS8								
	Buddhist Education*	A1, A2, A9	GS2, GS8								

No	Courses	PLO1	PLO2	PLO3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0
		Sub-PLO Attitude (A)	Sub-PLO Generic Skills (GS)		Sub-PLO Knowledge (K)				Sub-PLO Specific Skills (SS)		
	Hinduism Education*	A1, A2, A9	GS2, GS8								
	Confucianism Education*	A1, A2, A9	GS2, GS8								
2	Civic Education	A2, A3, A4, A5, A6, A7, A8	GS2, GS6, GS8	GS1, GS3							
3	Pancasila	A2, A3, A4, A5, A6, A7	GS2, GS6, GS8	GS1, GS3							
4	Bahasa Indonesia	A4, A6, A8, A9	GS2, GS8	GS4, GS9	K5						
5	English	A8, A9	GS2, GS8		K5						
6	Digital Transformation	A2, A8, A9	GS2, GS8	GS1, GS3	K5					SS4, SS5	SS3
7	Creativity, Innovation and Entrepreneurship	A9, A10	GS2, GS6, GS8	GS3	K5	K3					SS3
8	Social Literacy and Humanity	A2, A6, A8	GS2, GS6, GS8	GS1, GS3							SS3
9	Mathematics and Natural Sciences Insights and Studies	A6, A8, A9	GS2, GS6, GS8	GS3	K5	K3	K1			SS4	SS3
10	Statistics	A8, A9	GS2, GS8	GS5, GS9	K5		K1			SS4	SS3
11	General Chemistry	A8, A9	GS2, GS8			K3, K4	K1	K2	SS1, SS2	SS4	SS3
12	Physics for Chemistry	A8, A9	GS2, GS8				K1	K2			

No	Courses	PLO1	PLO2	PLO3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0
		Sub-PLO Attitude (A)	Sub-PLO Generic Skills (GS)		Sub-PLO Knowledge (K)				Sub-PLO Specific Skills (SS)		
13	Mathematics for Chemistry	A8, A9	GS2, GS8				K1	K2			
14	Chemical equilibrium	A8, A9	GS2, GS8			K4	K1	K2	SS1. SS2		SS3
15	Molecular Dynamics	A8, A9	GS2, GS8			K4	K1	K2	SS1, SS2	SS4	SS3
16	Fundamentals of Organic Chemistry	A8, A9	GS2, GS8			K3,K 4	K1	K2	SS1, SS2		SS3
17	Mechanism of Organic Reaction	A8, A9	GS2, GS8			K3,K 4	K1	K2	SS1, SS2		SS3
18	Metal Inorganic Chemistry	A8, A9	GS2, GS8			K3,K 4	K1	K2	SS1, SS2		SS3
19	Non-metal Inorganic Chemistry	A8, A9	GS2, GS8			K3,K 4	K1	K2	SS1, SS2		SS3
20	Fundamentals of Analytical Chemistry	A8, A9	GS2, GS8			K4	K1	K2	SS1, SS2		SS3
21	Chemical Separation Method	A8, A9	GS2, GS8			K4	K1	K2	SS1, SS2		SS3
22	Biochemistry	A8, A9	GS2, GS8			K4	K1	K2	SS1, SS2		SS3
23	Nuclear Chemistry	A8, A9	GS2, GS8				K1		SS2		SS3
24	Environmental Chemistry	A6, A8, A9	GS2, GS8			K4	K1	K2	SS2		SS3
25	Quantum Chemistry	A8, A9	GS2, GS8			K3	K1	K2	SS2	SS4	
26	Atomic and Molecular Spectroscopy	A8, A9	GS2, GS8			K4	K1	K2	SS1, SS2	SS4	SS3
27	Colloidal and Surface Chemistry	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3

No	Courses	PLO1	PLO2	PLO3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0
		Sub-PLO Attitude (A)	Sub-PLO Generic Skills (GS)		Sub-PLO Knowledge (K)				Sub-PLO Specific Skills (SS)		
28	Polymer chemistry	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
29	Physical Organic Chemistry	A8, A9	GS2, GS8			K3	K1	K2		SS4	SS3
30	Elusidasi Struktur Senyawa Organik	A8, A9	GS2, GS8			K3		K2	SS1, SS2	SS4	SS3
31	Natural Products Chemistry	A8, A9	GS2, GS8			K3			SS2		SS3
32	Coordination Chemistry	A8, A9	GS2, GS8			K3,K4	K1	K2	SS1, SS2		SS3
33	Crystallochemistry	A8, A9	GS2, GS8			K3	K1	K2	SS2	SS4	
34	Chemical Instrumentation	A8, A9	GS2, GS8			K3,K4		K2	SS1, SS2	SS4	
35	Chemical Laboratory Management	A8, A9	GS2, GS7, GS8			K4			SS1		
36	Physical Biochemistry	A8, A9	GS2, GS8			K4	K1	K2	SS1, SS2		SS3
37	Fundamental of Computational Chemistry	A8, A9	GS2, GS8	GS5		K3	K1		SS2	SS4, SS5	
38	Advanced of Computational Chemistry	A8, A9	GS2, GS8	GS5		K3	K1		SS2	SS4, SS5	
39	Selected Chemistry Research Topics	A8, A9	GS2, GS8	GS4, GS5, GS9	K5	K3	K1		SS2		SS3

No	Courses	PLO1	PLO2	PLO3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0
		Sub-PLO Attitude (A)	Sub-PLO Generic Skills (GS)		Sub-PLO Knowledge (K)				Sub-PLO Specific Skills (SS)		
40	Chemical Research Methodology	A8, A9	GS2, GS6, GS8	GS4, GS5, GS9	K5	K3,K4	K1		SS1, SS2	SS4	SS3
41	Chemical Application of Group Theory	A8, A9	GS2, GS8				K1	K2	SS2	SS5	SS3
42	Inorganic Chemical Synthesis	A8, A9	GS2, GS8			K3,K4	K1	K2	SS1, SS2		SS3
43	Solid Inorganic Chemistry	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
44	Structural Analysis of Inorganic Compounds	A8, A9	GS2, GS8			K3		K2	SS1, SS2	SS4	
45	Nanochemistry Technology	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
46	Bioinorganic	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
47	Organometal	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
48	Material Chemistry	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
49	Membrane Technology	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
50	Catalyst Chemistry	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
51	Geokimia	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
52	Kimia Farmasi	A8, A9	GS2, GS8			K3	K1		SS2		SS3
53	Molecular Biotechnology	A6, A8, A9	GS2, GS8			K3	K1		SS2		SS3
54	Food Chemistry	A8, A9	GS2, GS8			K3	K1		SS2		SS3

No	Courses	PLO1	PLO2	PLO3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0
		Sub-PLO Attitude (A)	Sub-PLO Generic Skills (GS)		Sub-PLO Knowledge (K)				Sub-PLO Specific Skills (SS)		
55	Synthetic of Organic Chemistry	A8, A9	GS2, GS8			K3	K1	K2	SS1, SS2		SS3
56	Isolation and Identification of Natural Material Compounds	A6, A8, A9	GS2, GS8			K3			SS1, SS2		SS3
57	Structural Analysis of Inorganic Compounds	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
58	Toxicology	A8, A9	GS2, GS8			K3	K1		SS2		SS3
59	Enzymology	A8, A9	GS2, GS8			K3	K1		SS2		SS3
60	Petroleum Chemistry and Energy	A6, A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
61	Fermentation Technology	A8, A9	GS2, GS8			K3	K1		SS2		SS3
62	Medicinal Chemistry	A8, A9	GS2, GS8			K3	K1		SS2		SS3
63	Electrochemical Analysis	A8, A9	GS2, GS8			K3		K2	SS2		SS3
64	Corrosion and Electroplating Chemistry	A8, A9	GS2, GS8			K3	K1		SS2		SS3
65	Radioanalysis	A8, A9	GS2, GS8				K1	K2	SS2		SS3
66	Management of hazardous wastes and toxic	A6, A8, A9	GS2, GS8	GS5		K4	K1	K2	SS2		SS3
67	Surfactants and Additives	A8, A9	GS2, GS8			K3	K1				SS3
68	Industrial Materials Analysis	A8, A9	GS2, GS8			K3	K1		SS2		SS3

No	Courses	PLO1	PLO2	PLO3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO1 0
		Sub-PLO Attitude (A)	Sub-PLO Generic Skills (GS)		Sub-PLO Knowledge (K)				Sub-PLO Specific Skills (SS)		
69	Chemical Industry	A8, A9	GS2, GS8			K3	K1	K2	SS2		SS3
70	Industrial Management	A8, A9	GS2, GS8	GS5,GS7		K4			SS2		SS3
71	Entrepreneurial Practice	A8, A9, A10	GS2, GS6, GS7, GS8	GS5		K3					SS3
72	Industrial Internship	A8, A9	GS2, GS6, GS7, GS8	GS5, GS9	K5	K3, K4	K1	K2	SS1, SS2	SS4	SS3
73	Internship	A8, A9	GS2, GS6, GS7, GS8	GS5, GS9	K5	K3, K4	K1	K2	SS1, SS2	SS4	SS3
74	Community Service	A2, A3, A4, A5, A6, A7, A8, A9,A10	GS2, GS6, GS7, GS8	GS1,GS3GS5		K4		K2			SS3
75	Thesis	A8, A9, A10	GS2, GS6, GS8	GS4, GS5, GS9	K5	K3, K4	K1	K2	SS1, SS2	SS4, SS5	SS3

E. Curriculum Structure and Course Distribution

1. Curriculum Structure

The results of the study mapping, in accordance with the concept of the MBKM curriculum, the types of courses in the MBKM Curriculum structure of the UNY Chemistry Study Program are grouped into 3 (three), namely (a) Main Course Group, (b) Additional Course Group, and (c) Courses Outside the Chemistry Study Program within UNY and outside UNY.

a. Main Courses/Mata Kuliah Utama (MKU). This courses are aimed at fulfilling the mail PLOs in the Chemistry Study Program, which based on their characteristics are divided into 4 (four) groups, i.e.

1) University Courses/Mata Kuliah University (MKU)

Are courses at university level to develop character and nationality, also to achieve the university's vision and mission.

2) **Faculty Courses/Mata Kuliah Fakulter (FMI)**
   Are courses as faculty characteristic to develop generic knowledge in the faculty level.
3) **Study Program Courses/Mata Kuliah Program Studi (MKPS)**
   Are expertise courses in the field of chemistry developed by the Chemistry Study Program to develop student competencies in chemistry. **Study Program courses can be taken outside of UNY with a credit transfer scheme.**
4) **Study Program Courses/Mata Kuliah Program Studi (MKPS) that carried out outside university**
   Consist of Internship/Praktik Kerja Lapangan (PKL), Community Service (KKN), dan Thesis/Tugas Akhir Skripsi (TAS).

b. Additional Courses or Specialization Courses

Are courses to support main PLOs achievement, consist of advanced courses and excellent/characteristic/specialization of study program's courses. **Additional or specialization courses can be taken outside of UNY with a credit transfer scheme.**

c. Outside Study Program Courses

Are elective courses chosen by students to fulfill the main PLOs which taken outside study program or outside university, consist of

1) **Outside Study Program Courses inside UNY/Mata Kuliah Luar Program Studi di dalam UNY (MKLD)**
   Are elective courses to fulfill main PLOs and additional PLOs taken outside study program inside UNY
2) **Outside Study Program Courses outside University/Mata Kuliah Luar Program Studi di luar UNY (MKLL)**
   Are elective courses to fulfill main PLOs and additional PLOs taken outside study program outside UNY

Based on Peraturan Rektor UNY No. 7 Tahun 2020 concerning Panduan Implementasi Kurikulum MBKM Program Sarjana dan Sarjana Terapan UNY, in the curriculum structure of Chemistry Study Program, there are 3 (three) study period patterns offered by the study program. The study period pattern is a pattern of the credits load and/or semesters that must be taken in the Chemistry Study Program, outside the Chemistry Study Program within UNY, and outside the Chemistry Study Program outside UNY (Table 8). The study period pattern outside the Chemistry Study Program outside UNY can be taken at the same and/or different study programs outside UNY both at higher education institutions, formal/non-formal education institutions, business and industrial institutions, community institutions, government agencies, and or other relevant institutions.

In the MBKM curriculum of the UNY Chemistry Study Program, the number of courses that must be taken by students to obtain a chemistry undergraduate degree is 146-156 credits through several patterns as shown in Table 8. **This study period pattern is chosen by students at the** end **of semester 2 (two)**.

2. Course Distribution

The distribution pattern of courses in the MBKB Curriculum of the UNY Chemistry Study Program in accordance with the learning period pattern is shown in Table . The distribution of these courses is arranged based on main and additional courses, as well as the location/place of taking courses that can be taken within UNY or outside UNY.

Table 8. Learning Period Patterns

Pattern	Period (semester)			Total semester
	Inside Study Program	Outside Study Program inside UNY	Outside UNY (Other university/ industry/society)	
5-1-2	5 (100-104) sks	1 (18-20) sks	2 (28-32) sks	8 (146-156) sks
6-1-1	6 (114-120) sks	1 (12-16) sks	1 20 sks	8 (146-156) sks
6-0-2	6 (110-116) sks	0 0 sks	2 (36-40) sks	8 (146-156) sks

Table 9. Course Distribution at MBKM curriculum of Chemistry Study Program UNY

No	Course Dsitribution	Pattern (credits)		
		5-1-2	**6-1-1**	**6-0-2**
1	**Courses inside UNY**			
	a. Main Courses Group			
	● Compulsory University Course	14	14	14
	● Elective University Course	2	2	2
	● Faculty course	4	4	4
	● Chemistry Study Program Courses	80	80	80
	b. Additional Courses Group			
	● Advance Courses, Excellent/ Characteristic/Specialization Courses at Chemistry Study Program	0-4	14-20	10-16
	● Advance Courses, Excellent/ Characteristic/Specialization Courses outside Chemistry Study Program	18-20	12-16	0
2	**Courses outside UNY**			
	a. Compulsory Courses Group of PKL, KKN and TAS	20	20	20
	b. Additional Courses (Advance Courses, Excellent/ Characteristic/Specialization Courses outside UNY)	8-12	0	16-20
	Total	**146-156**	**146 - 156**	**146 - 156**

The description of course names and credits in each group of courses is as follows:

a. Courses inside UNY

1) University Courses Mata kuliah University (MKU) 16 sks

University courses (MKU) are 16 credits with a distribution as shown in Table 10

Table 10. University Courses (MKU) at Chemistry Study Program

No.	Code	Course Name	Detail credits				Semester		SMT
			T	P	F	Total	Odd	Even	
Compulsory MKU									
1	MKU6201	Islamic Education*	2*			2	√		1
	MKU6202	Catholic Education*	2*			2	√		1
	MKU6203	Christian Education*	2*			2	√		1
	MKU6204	Buddhist Education*	2*			2	√		1
	MKU6205	Hinduism Education*	2*			2	√		1
	MKU6206	Confucianism Education*	2*			2	√		1
2	MKU6207	Civic Education	2			2	√		1
3	MKU6208	Pancasila	2			2		√	2
4	MKU6209	Indonesian	2			2		√	4
5	MKU6211	English	2			2		√	2
6	MKU6212	Digital Transformation**	2			2	√		1
7	MKU6213	Creativity, Innovation, and Entrepreneurship**	2			2	√		1
		Sub Total Compulsory MKU	**14**	**-**	**-**	**14**			
Elective MKU									
8	MKU6216	Social Literacy and Humanity	2			2	√		1
		Sub Total Elective MKU	**2**	**-**	**-**	**2**			
		Total MKU	**16**	**-**	**-**	**16**			

Note:

*) choose one depending on the religion

**) Competency in line with study program characteristic

T = Theory, P= Practice dan F = Field

2) Faculty Course (FMI) 4 sks

Faculty courses (FMI) are 4 credits with a distribution as shown in Table 11.

Table 11. Faculty Courses (FMI) at Chemistry Study Program

No.	Code	Course name	Detail Credits				Semester		SMT
			T	P	F	Total	Odd	Even	
1	FMI6201	Mathematics and Natural Sciences Insights and Studies	2			2		√	2
2	FMI6202	Statistics	2			2		√	2
		Total FMI	**4**	**-**	**-**	**4**			

3) Chemistry Study Program Courses 80 credits

The Chemistry Study Program courses consist of 80 credits of main courses and additional/specialization courses with the number of credits according to the study period pattern chosen by the students (0-4 credits for 5-0-2 pattern; 14-20 credits for 6-1-1 pattern; and 10-16 credits for 6-0-2 pattern). Specialization courses are grouped into 4 (four) fields of study, namely (1) specialization group of renewable and functional material competencies, (2) specialization group of biological chemistry competencies, and (3) specialization group of environmentally friendly chemistry competencies, and (4). The selection of specialization courses for the Chemistry Study Program is based on the suitability of the theme of the thesis to be prepared, and includes a minimum of 4 credits of courses in the appropriate study group.

a) Main Chemistry Study Program Courses (MKPS)

The main Chemistry Study Program Courses are listed in Table 12.

Table 12. List of Main Chemistry Study Program Courses

No.	**Code**	**Course Name**	**Detail credits**				**Semester**		**SMT**
			T	**P**	**F**	**Total**	**Odd**	**Even**	
1	KIM6401	General Chemistry	3	1		4	√		1
2	KIM6202	Physics for Chemistry	2			2	√		1
3	KIM6303	Mathematics for Chemistry	3			3	√		1
4	KIM6404	Chemical Equilibrium	3	1		4		√	2
5	KIM6405	Molecular Dynamics	3	1		4	√		3
6	KIM6406	Fundamentals of organic Chemistry	3	1		4	√		3
7	KIM6307	Structure and Reactivity of Organic Compounds	2	1		3		√	4
8	KIM6308	Metal Inorganic Chemistry	2	1		3	√		3
9	KIM6309	Non-metal Inorganic Chemistry	2	1		3		√	2
10	KIM6410	Fundamentals of Analytical Chemistry	3	1		4		√	2
11	KIM6311	Chemical Separation Method	2	1		3	√		3

12	KIM6412	Biochemistry	3	1		4		√	4
13	KIM6213	Nuclear Chemistry	2			2		√	4
14	KIM6214	Environmental Chemistry	2			2		√	2
15	KIM6215	Quantum Chemistry	2			2	√		3
16	KIM6216	Atomic and Molecular Spectroscopy	2			2	√		5
17	KIM6217	Colloidal and Surface Chemistry	2			2	√		5
18	KIM6218	Polymer Chemistry	2			2	√		5
19	KIM6219	Physical Organic Chemistry	2			2	√		5
20	KIM6220	Determination of the Structure of Organic Chemistry	2			2	√		5
21	KIM6221	Natural Product Chemistry	2			2	√		5
22	KIM6322	Coordination Chemistry	2	1		3		√	4
23	KIM6223	Crystallochemistry	2			2	√		5
24	KIM6324	Chemical Instrumentation	2	1		3		√	4
25	KIM6225	Chemical Laboratory Management	2			2	√		3
26	KIM6226	Physical Biochemistry	2			2	√		5
27	KIM6227	Fundamentals of Computational Chemistry	1	1		2		√	2
28	KIM6228	Advanced Computational Chemistry	1	1		2	√		3
29	KIM6229	Selected Chemical Research Topics	2			2	√		5
30	KIM6330	Chemical Research Methodology	3			3	√		6
		Total Main MKPS	**66**	**14**	**-**	**80**			

b) Additional Main Chemistry Study Program Courses

a) MKPS Specialization in Renewable and Functional Materials

No.	**Code**	**Course Name**	**Detail credits**				**Semester**		**SMT**
			T	**P**	**F**	**Total**	**Odd**	**Even**	
1	KIM6231	Chemical Applications of Group Theory	2			2			
2	KIM6232	Inorganic Chemical Synthesis	2			2			
3	KIM6233	Solid Inorganic Chemistry	2			2			
4	KIM6234	Structural Analysis of Inorganic Compounds	2			2			
5	KIM6235	Nanochemistry Technology	2			2			
6	KIM6236	Bioinorganic	2			2			
7	KIM6237	Organometal	2			2			

8	KIM6238	Material Chemistry	2			2			
9	KIM6239	Membrane Technology	2			2			
10	KIM6240	Catalyst Chemistry	2			2			

b) MKPS Specialization in Biological Chemistry

No.	Code	Course Name	Detail credits				Semester		SMT
			T	P	F	Total	Odd	Even	
1	KIM6241	Pharmaceutical Chemistry	2			2		√	
2	KIM6242	Molecular Biotechnology Chemistry	2			2		√	
3	KIM6243	Food Chemistry	2			2		√	
4	KIM6244	Synthetic Organic Chemistry	2			2	√		
5	KIM6245	Isolation and Identification of Natural Material Compounds	2			2	√		
6	KIM6246	Organic Compound Reaction Mechanism	2			2			
7	KIM6247	Toxicology	2			2	√		
8	KIM6248	Enzymology	2			2	√		
9	KIM6249	Petroleum Chemistry and Energy	2			2	√		
10	KIM6250	Fermentation Technology	2			2	√		
11	KIM 6262	Medicinal Chemistry	2			2		√	

c) MKPS Specialization in Environmental Friendly Chemistry

No.	Code	Course Name	Detail credits				Semester		SMT
			T	P	F	Total	Odd	Even	
1	KIM6251	Electrochemical Analysis	2			2	√		
2	KIM6252	Corrosion and Electroplating Chemistry	2			2	√		
3	KIM6254	Radioanalysis	2			2			
4	KIM6255	Management of Hazardous and Toxic Waste	2			2		√	
5	KIM6256	Surfactants and Additives	2			2			

d) MKPS Specialization in Industrial Chemistry and Entrepreneur

No.	Code	Course name	Detail credits				Semester		SMT
			T	P	F	Total	Odd	Even	
1	KIM6253	Industrial Material Analysis	2			2		√	
2	KIM6257	Industrial Chemistry	2					√	
3	KIM6258	Industrial Management	2				√		
4	KIM6260	Enterpreneurship Practice			2		√	√	
5	KIM6261	Industrial Internship			2-6		√	√	

4) Outside Chemistry Study Program Inside UNY (MKLD)

The MBKM curriculum facilitates students to take courses outside the Chemistry Study Program both in similar and different study programs within UNY. These courses are in the form of additional courses to fulfill additional PLOs that enrich the competencies of Chemistry Study Program graduates and support the profile of graduates desired by students (Table 2). The course code from outside the study program follows the course code in the study program where students take the course. The additional PLOs include:

(a) Students have the ability to analyze research data precisely and accurately in accordance with the development of information technology.
This competency can be fulfilled by students taking courses in the UNY Statistics Study Program or other study programs at UNY that offer similar courses.

(b) Students have the skills to operate supporting instruments for chemical analysis.
This competency can be fulfilled by students taking courses in the Physics Study Program at UNY or other study programs at UNY that offer similar courses.

(c) Students have the ability to master minimalist theoretical concepts in using the services of living things to support chemical research.
This competency can be fulfilled by students taking courses in the Biology Study Program at UNY or other study programs at UNY that offer similar courses.

(d) Students have knowledge about industrial management, especially the chemical industry in a safe, efficient and effective manner.
This competency can be fulfilled by taking courses in study programs under the Faculty of Engineering UNY or other study programs at UNY that offer similar courses.

(e) Students have the ability to master the theoretical concept of minimalism in chemistry learning.

This competency can be fulfilled by students taking courses in the Chemistry Education Study Program at UNY or other study programs at UNY that offer similar courses.

(f) Students have the ability to master the theoretical concepts of minimalism in the field of entrepreneurship.
This competency can be fulfilled by students taking courses in the UNY Chemical Economics and Management Study Program or other study programs at UNY that offer similar courses.

5) Outside University Courses (MKLL)

Courses outside UNY (MKLL) are courses taken by students to fulfill the main ELOs which are mandatory, and to fulfill additional ELOs which are free choice to support the achievement of graduate profiles. The total credits of the main MKLL are 20 credits consisting of 6 credits of Field Work Practice (PKL), 6 credits of Community Service (KKN) and 8 credits of Final Thesis (TAS) (Table 13).

Courses outside UNY to fulfill additional CP can be done by taking courses at other universities, especially partner universities both online and offline. In addition, MKLL can be carried out by carrying out several activities outside the PT that support ELOs. There are 8 (eight) alternative forms of activity, i.e.:

1) Industrial Internship,
2) Project in Village,
3) Students Exchange,
4) Research
5) Entrepreneur activities,
6) Independent Study/Project,
7) Humanitarian Project, and
8) Teaching in School.

Table 13. Outside University Courses (20 credits)

No.	Code	Course name	Detail credits				Semester		SMT
			T	P	F	Total	Odd	Even	
1	MKL6603	Internship			6	6			
2	MKL6604	Community Service			6	6			
3	TAM6801	Thesis			8	8			
		Total Main MKLL	**-**	**-**	**20**	**20**			

The equality of the weight of these activities with the weight of SKS can be done in free form (free form) and structured form (structured form). The free form is expressed in the form of competencies obtained by students while participating in the activity program, both in hard skills and soft skills in accordance with the desired learning outcomes. Meanwhile, equality in a structured form is carried out by adjusting these activities to the curriculum taken by students.

b. Course Distribution Per Semester

The distribution of courses per semester in the Chemistry Study Program of UNY is divided into 3 study period patterns, namely 5-1-2, 6-1-1, and 6-0-2.

a) Course Distribution pattern 5-1-2

Semester 1

No	Code	Course name	T	P	F	Total
1	MKU6201	Islamic Education*	2*			2
	MKU6202	Catholic EDucation *	2*			2
	MKU6203	Christian Education*	2*			2
	MKU6204	Buddhist Education*	2*			2
	MKU6205	Hinduism Education*	2*			2
	MKU6206	Confucianism Education*	2*			2
2	MKU6207	Civic Education	2			2
3	MKU6211	English	2			2
4	MKU6212	Digital Transformation	2			2
5	MKU6213	Creativity, Innovation and Entrepreneurship	2			2
6	MKU6216	Social Literacy and Humanity	2			2
7	KIM6401	General Chemistry	3	1		4
8	KIM6202	Physics for Chemistry	2			2
9	KIM6303	Mathematics for Chemistry	3			3
Total credits			**20**	**1**		**21**

Semester 2

No	Code	Course name	T	P	F	Total
1	MKU6208	Pancasila	2			2
2	FMI6201	Mathematics and Natural Sciences Insights and Studies	2			2
3	FMI6202	Statistics	2			2
4	KIM6404	Chemical Equilibrium	3	1		4
5	KIM6309	Non-metal Inorganic Chemistry	2	1		3
6	KIM6214	Environmental Chemistry	2			2
7	KIM6410	Fundamental of Analytical Chemistry	3	1		4
8	KIM6227	Fundamental of Computational Chemistry	2			2
Total credits			**18**	**3**		**21**

Semester 3

No	Code	Course name	T	P	F	Total
1	KIM6405	Molecular Dynamics	3	1		4
2	KIM6406	Fundamental of Organics Chemistry	3	1		4
3	KIM6309	Metal Inorganic Chemistry	2	1		3
4	KIM6311	Chemical Separation Method	2	1		3
5	KIM6215	Quantum Chemistry	2			2
6	KIM6225	Chemical Laboratory Management	2			2
7	KIM6228	Advanced of Computational Chemistry	1	1		2
8		Outside Study Program Course inside UNY	2			2
Total Credits			**17**	**5**		**22**

Semester 4

No	Code	Course name	T	P	F	Total
1	MKU6209	Bahasa Indonesia	2			2
2	KIM6307	Structure and Reactivity of Polyfunctional Compounds	2	1		3
3	KIM6412	Biocehmistry	3	1		4
4	KIM6213	Nuclear Chemistry	2			2
5	KIM6218	Polymer Chemistry	2			2
6	KIM6322	Coordination Chemistry	2	1		3
7	KIM6324	Chemical Instrumentation	2	1		3
8		Outside Study Program Course inside UNY	2			2
Total Credits			**17**	**4**	**-**	**21**

Semester 5

No	Code	Course name	T	P	F	Total
1	KIM6217	Colloidal and Surface	2			2
2	KIM6219	Physical Organic Chemistry	2			2
3	KIM6220	Determination of the structure of Organic Compounds	2			2
4	KIM6221	Natural Products Chemistry	2			2
5	KIM6322	Coordination Chemistry	2			2
6	KIM6223	Crystallochemistry	2			2
7	KIM6226	Physical Biochemistry	2			2
8	KIM6229	Molecular Biotechnology	2			2
9		Outside Study Program Course inside UNY	6			6
Total Credits			**22**	**-**	**-**	**22**

Semester 6

No	Code	Course name	T	P	F	Total
1	KIM6330	Chemical Research Methodology	3			3
2		Outside Study Program Course inside UNY	8			8
3		Additional Courses outside UNY	8			8
Total credits			**19**	**-**	**-**	**19**

Semester 7

No	Code	Course name	T	P	F	Total
1	MKL 6603	Internship			6	6
2	MKL 6604	Community Service			6	6
Total Credit			**-**	**-**	**12**	**12**

Semester 8

No	Code	Course name	T	P	F	Total
1	TAM 6801	Thesis	8			8
Total credits			**8**	**-**	**-**	**8**

b) Course Distribution Pattern 6-1-1

Semester 1

No	Code	Course name	T	P	F	Total
1	MKU6201	Islamic Education*	2*			2
	MKU6202	Catholic Education*	2*			2
	MKU6203	Christian Education*	2*			2
	MKU6204	Buddhist Education*	2*			2
	MKU6205	Hinduism Education*	2*			2
	MKU6206	Confucian Education*	2*			2
2	MKU6207	Civic Education	2			2
3	MKU6211	English	2			2
4	MKU6212	Digital Transformation	2			2
5	MKU6213	Creativity, Innovation and Entrepreneurship	2			2
6	MKU6216	Social Literacy and Humanity	2			2
7	KIM6401	General Chemistry	3	1		4
8	KIM6202	Physics for Chemistry	2			2
9	KIM6303	Mathematics for Chemistry	3			3
Total credits			**20**	**1**	-	**21**

Semester 2

No	Code	Course name	T	P	F	Total
1	MKU6208	Pancasila	2			2
2	FMI6201	Study of Mathematics and Natural Sciences	2			2
3	FMI6202	Statistics	2			2
4	KIM6404	Chemical equilibrium	3	1		4
5	KIM6309	Non-metal Inorganic Chemistry	2	1		3
6	KIM6214	Environmental Chemistry	2			2
7	KIM6410	Fundamentals of Analytical Chemistry	3	1		4
8	KIM6227	Fundamental of Computational Chemistry	2			2
Total credits			**18**	**3**	**-**	**21**

Semester 3

No	Code	Course name	T	P	F	Total
1	KIM6405	Molecular Dynamics	3	1		4
2	KIM6406	Fundamentals of Organic Chemistry	3	1		4
3	KIM6309	Metal Inorganic Chemistry	2	1		3
4	KIM6311	Chemical Separation Method	2	1		3
5	KIM6215	Quantum Chemistry	2			2
6	KIM6225	Chemical Laboratory Management	2			2
7	KIM6228	Advanced of Computational Chemistry	1	1		2
8		Specialization Study Program Courses	2			2

Total credits	**17**	**5**	-	**22**

Semester 4

No	Code	Course name	T	P	F	Total
1	MKU6209	Bahasa Indonesia	2			2
2	KIM6307	Structure and Reactivity of Organic Compounds	2	1		3
3	KIM6412	Biochemistry	3	1		4
4	KIM6213	Nuclear Chemistry	2			2
5	KIM6218	Polymer chemistry	2			2
6	KIM6322	Coordination Chemistry	2	1		3
7	KIM6324	Chemical Instrumentation	2	1		3
8		Specialization Study Program Courses	2			2
Total credits			**17**	**4**	-	**21**

Semester 5

No	Code	Course name	T	P	F	Total
1	KIM6217	Colloidal and Surface Chemistry	2			2
2	KIM6219	Physical Organic Chemistry	2			2
3	KIM6220	Determination of the structure of Organic Compounds	2			2
4	KIM6221	Natural Products Chemistry	2			2
5	KIM6322	Coordination Chemistry	2			2
6	KIM6223	Crystallochemistry	2			2
7	KIM6226	Physical Biochemistry	2			2
8	KIM6229	Molecular Biotechnology	2			2
9		Specialization Study Program Courses	2			2
10		Outside Study Program Course inside UNY	4			4
Total credits			**22**	**-**	-	**22**

Semester 6

No	Code	Course name	T	P	F	Total
1	KIM6330	Chemical Research Methodology Metodologi	3			3
2		Specialization Study Program Courses	8			8
3		Outside Study Program Course inside UNY	8			8
Jumlah sks			**19**	**-**	**-**	**19**

Semester 7

No	Code	Course name	T	P	F	Total
1	MKL 6603	Internship			6	6
2	MKL 6604	Community Service			6	6
Total credits			**-**	**-**	**12**	**12**

Semester 8

No	Code	Course name	T	P	F	Total
1	TAM 6801	Thesis	8			8
Total credits			**8**	**-**	**-**	**8**

c) Distribusi Mata Kuliah Pola 6-0-2

Semester 1

No	Code	Course name	T	P	F	Total
1	MKU6201	Islamic Education*	2*			2
	MKU6202	Catholic Education*	2*			2
	MKU6203	Christian Education*	2*			2
	MKU6204	Buddhist Education*	2*			2
	MKU6205	Hinduism Education*	2*			2
	MKU6206	Confucianism Education*	2*			2
2	MKU6207	Civic Education	2			2
3	MKU6211	English	2			2
4	MKU6212	Digital Transformation	2			2
5	MKU6213	Creativity, Innovation and Entrepreneurship	2			2
6	MKU6216	Social Literacy and Humanity	2			2
7	KIM6401	General Chemistry	3	1		4
8	KIM6202	Physics for Chemistry	2			2
9	KIM6303	Mathematics for Chemistry	3			3
Total credits			**20**	**1**	-	**21**

Semester 2

No	Code	Course name	T	P	F	Total
1	MKU6208	Pancasila	2			2
2	FMI6201	Study of Mathematics and Natural Sciences	2			2
3	FMI6202	Statistics	2			2
4	KIM6404	Chemical equilibrium	3	1		4
5	KIM6309	Non-metal Inorganic Chemistry	2	1		3
6	KIM6214	Environmental Chemistry	2			2
7	KIM6410	Fundamentals of Analytical Chemistry	3	1		4
8	KIM6227	Fundamental of Computational Chemistry	2			2
Total credits			**18**	**3**	**-**	**21**

Semester 3

No	Code	Course name	T	P	F	Total
1	KIM6405	Molecular Dynamics	3	1		4
2	KIM6406	Fundamentals of Organic Chemistry	3	1		4
3	KIM6309	Metal Inorganic Chemistry	2	1		3
4	KIM6311	Chemical Separation Method	2	1		3

5	KIM6215	Quantum Chemistry	2			2
6	KIM6225	Chemical Laboratory Management	2			2
7	KIM6228	Advanced of Computational ChemistryKimia Komputasi Lanjut	1	1		2
8		Specialization Study Program Courses	2			2
Total credits			**17**	**5**	**-**	**22**

Semester 4

No	Code	Course name	T	P	F	Total
1	MKU6209	Bahasa Indonesia	2			2
2	KIM6307	Structure and Reactivity of Organic Compounds	2	1		3
3	KIM6412	Biochemistry	3	1		4
4	KIM6213	Nuclear Chemistry	2			2
5	KIM6218	Polymer chemistry	2			2
6	KIM6322	Coordination Chemistry	2	1		3
7	KIM6324	Chemical Instrumentation	2	1		3
8		Specialization Study Program Courses	2			2
Total credits			**17**	**4**	**-**	**21**

Semester 5

No	Code	Course name	T	P	F	Total
1	KIM6217	Colloidal and Surface Chemistry	2			2
2	KIM6219	Physical Organic Chemistry	2			2
3	KIM6220	Determination of the structure of Organic Compounds	2			2
4	KIM6221	Natural Products Chemistry	2			2
5	KIM6322	Coordination Chemistry	2			2
6	KIM6223	Crystallochemistry	2			2
7	KIM6226	Physical Biochemistry	2			2
8	KIM6229	Molecular Biotechnology	2			2
		Specialization Study Program Courses	2			2
9		Outside UNY Courses	4			4
Total credits			**22**	-	**-**	**22**

Semester 6

No	Code	Course name	T	P	F	Total
1	KIM6330	Chemical Research Methodology	3			3
2		Specialization Study Program Courses	6			6
3		Outside UNY Courses	12			12
Total credits			**21**	**-**	**-**	**21**

Semester 7

No	Code	Course name	T	P	F	Total

1	MKL 6603	Internship			6	6
2	MKL 6604	Community Service			6	6
Total credits			**-**	**-**	**12**	**12**

Semester 8

No	Code	Course name	T	P	F	Total
1	TAM 6801	Thesis	8			8
Total credits			**8**	**-**	**-**	**8**

F. Learning Process

The learning process in the Chemistry Study Program is strived to provide optimal results. Lecturers and study program managers are required to have a good understanding in the importance of didactic methods and instruments to achieve optimal learning outcomes. Before carrying out their duties as lecturers, lecturers in the study program have received applied approach training, so that the ability to deliver lecture material, both content and the chosen approach/method/model is expected to be very appropriate. The refreshing process to better understand didactical methods and instruments is also carried out through methodological training organized by the Institute of Quality Assurance and Educational Development when needed. Online-based teaching training is also conducted, including the use of Be Smart, Google Classroom, Zoom, Google meetings and other applications.

The role of lecturers in learning activities includes designing the curriculum, organizing team teaching, designing learning contracts, lesson plans and assessments, and learning activities. The teaching team consists of lecturers who have the same field of expertise. Each course has Course Learning Outcomes (CLO) which are the implementation and derivatives of PLOs. Each PLO is composed of one or more CLOs with the assessment process carried out by the teaching team through exams, which can be in the form of midtest, final test, or others.

The learning approach used is Student Centered Learning (SCL). Examples of learning models that apply the SCL approach include group discussion, problem-based learning, and project-based learning. The method used is proven to be able to create students to play an active role in learning, so that the produced graduates are more competitive in the global era.

The preparation of independent scientific work prepared by students is supported by the Chemistry Research Methodology course. This course guides students in conducting chemical research, preparing thesis manuscripts, and publishing scientific work in the form of articles in indexed scientific journals and indexed seminar proceedings. The products of this course are research proposal drafts and scientific article drafts that are ready to be submitted to journals and proceedings.

The learning process can be monitored at any time by the Study Program Coordinator through siakad2013.uny.ac.id, and monitored at the beginning and end of the semester by students. Students are directly involved in monitoring and evaluating lectures managed by each lecturer by filling out lecture questionnaires at the beginning and end of each semester. Lecture questionnaires are filled out online through http://emonev.lppmp.uny.ac.id/. The results of this monitoring are then given to each lecturer to be used as evaluation material for lecturers to

improve the quality of lectures. The results of monitoring lectures are discussed in the faculty plenary meeting at the end of each semester. The highest and lowest scores in lecture monitoring are also discussed in the faculty plenary meeting with the hope that lecturers will have more motivation in improving lectures.

UNY's support for the success of the learning process and learning outcomes to produce graduates with good achievements on time is realized by providing various facilities. The provided facilities are laboratories, libraries, e-learning, academic guidance, career guidance, and various other facilities. Facilities that support student learning success are information systems both hardware and software. The chemistry study program's online information system has progressed, mainly related to online access provided by UNY because the university has developed an SSO (Single Sign On) system, where UNY staff and students can use all online facilities with one log in.

There is a consultation and mentoring facility that is most effective in supporting student academic achievement in the form of academic guidance carried out by academic advisors. Each new student is accompanied by one academic advisor. This assistance by academic advisors provides an opportunity for students to consult regarding academic problems that are difficult to solve independently by students. Academic advisors also try to find solutions to problems faced by students. Even if necessary, the academic advisor through the study program will invite other parties who are potentially able to solve the problems faced by students.

Assistance offered by the Chemistry Study Program for students includes academic guidance, counseling guidance, guidance on obtaining scholarships, career guidance, fostering interests and talents, and religious assistance. All forms of consultation and assistance are well utilized by students to shorten the study period, as well as improve student achievement.

Furthermore, students who will take the Thesis course will be guided by one lecturer who has a minimum functional position of Lector. These thesis supervisors are tasked with helping students complete their research as a final project. The supervisor is also tasked with monitoring the progress of each student's thesis through the thesis guidance card so they can ensure the timeline when students can complete the thesis. Thesis guidance can also be done online through the page http://bimbingan.uny.ac.id/. The existence of online guidance facilities will make it easier for students to flexibly consult with supervisors related to the thesis so the students can complete their studies on time.

The laboratory facilities of the Chemistry Study Program, FMIPA, UNY are quite complete. The laboratory facilities provided include Basic Chemistry, Organic Chemistry and Biochemistry, Physical and Inorganic Chemistry, and Analytical Chemistry laboratories to organize practicum-based learning activities. As for research activities, separate research laboratory facilities have been provided. An integrated laboratory containing chemical instruments to analyze research samples is also available. Furthermore, there is a computer laboratory that has 44 computers and has been connected to the Local Area Network (LAN) with the FMIPA UNY environment which can be utilized for computer application practicum, chemical computing, preparation of computer-assisted learning materials, analysis of chemical education research data, and access to global information via the internet and e-library. The facilities that have been provided are expected to support and facilitate student learning activities so that students can complete their studies on time.

G. Assesment

Assessment based on Permenristekdikti No. 44 of 2015 includes process assessment and assessment of student learning outcomes. Assessment of learning outcomes according to Article 19 of the Permenristekdikti consists of principles, techniques, mechanisms, procedures and assessment reporting. Assessment principles include educational, authentic, objective, accountable, and transparent principles that are carried out in an integrated manner. Educational principles in assessment must be able to motivate students to (a) improve planning and learning methods; and (b) achieve graduate learning outcomes. Authentic assessment is an assessment that is oriented towards the continuous learning process and learning outcomes that reflect students' abilities during the learning process. Objective assessment is an assessment based on standards agreed between lecturers and students and free from the influence of the subjectivity of the assessor and the assessed. Accountable assessment is an assessment carried out in accordance with clear procedures and criteria, agreed upon at the beginning of the lecture, and understood by students. Transparent assessment is an assessment whose procedures and results can be accessed by all stakeholders.

The scope of assessment is knowledge mastery assessment, attitude assessment, generic and specific skills. While the learning assessment technique in the Chemistry Study Program consists of observation, participation, performance, written tests, oral tests, and questionnaires. The assessment instrument used is an assessment instrument validated by the head of the Chemistry Education department. Attitude assessment can use observation assessment techniques. Assessment of mastery of knowledge, generic skills, and specific skills is carried out by choosing one or a combination of various assessment techniques and instruments. The final result of the assessment is an integration of the various assessment techniques and instruments used.

The assessment mechanism consists of (a) compiling, conveying, agreeing on the stages, techniques, instruments, criteria, indicators, and assessment weights between the assessor and the assessed in accordance with the learning plan; (b) carrying out the assessment process in accordance with the stages, techniques, instruments, criteria, indicators, and assessment weights that contain the principles of assessment; (c) providing feedback and opportunities to question the assessment results to students; and (d) documenting the assessment of student learning processes and outcomes in an accountable and transparent manner. Assessment procedures include the planning stage, assigning tasks or questions, observing performance, returning observation results, and giving final grades. Assessment procedures at the planning stage can be carried out through gradual assessment and/or reassessment. The implementation of the assessment can be carried out by (a) teaching lecturers or a team of teaching lecturers, (b) teaching lecturers or a team of teaching lecturers by involving students; and / or (c) teaching lecturers or a team of teaching lecturers by including relevant stakeholders.

Assessment in the Chemistry Study Program is carried out in an examination system which is a series of procedures to check whether students have met the qualifications of course learning outcomes. Each lecturer in charge of the course is obliged to design an examination system in accordance with the planned learning method with a form to verify learning outcomes. The types of exams consist of: (a) theory course exams, (b) practicum course exams and/or reports, (c) practical course exams and/or reports, (d) seminar course exams and/or

assignments, as well as (e) field activity reports and exams, and (f) final project exams, (g) and other specified assignments.

The thesis final project exam (TAS) is the decisive exam from a series of lectures scheduled in 8 semesters. Students can apply for the TAS exam if they have completed laboratory research and report writing in the form of a TAS script by showing proof that it has been approved by the supervisor. The TAS examination is carried out if the student has met the requirements set by the Study Program and is carried out based on the applicable TAS examination guidelines.

Practical Course Examinations are regulated by the faculty, department, study program. Field Work Practice Course exam bills are regulated by departments and study programs in the form of PKL reports written according to PKL guidelines. As for the real work course, the series of implementation processes are regulated by the Institute for Research and Community Service (LPPM). The KKN exam bill is in the form of KKN reports and community service articles in accordance with established guidelines.

The midterm and final exams are scheduled and arranged by the study program. However, students can apply for a supplementary exam with rational reasons (illness or other reasons that can be proven) with the approval of the lecturer. The procedure is students need to submit a request to take the supplementary exam by attaching physical evidence of the reason for not being able to take the exam on the main schedule (for example: a doctor's certificate of illness) to the lecturer in charge of the course during the semester before the final grade deadline (2 weeks after the final semester exam schedule). If the lecturer agrees, the lecturer and student find a suitable time and place from both parties.

Both midterm and final exams are conducted on a scheduled basis, so that the guarantee of their implementation can be controlled by the system outside the classroom, namely by the person in charge of the study program. Control of the examination function is carried out on the examination instrument to make it valid and reliable by means of every time before the end of semester exam, the lecturer proposes an exam question to the head of the study program, who will then control the exam instrument package through consultation with the head of the expertise field that oversees the controlled course, related to the expertise of the field. Once approved and ratified, the questions can be used to conduct the final semester exams for students. Therefore, all forms of examinations organized by the study program are able to verify the learning outcomes obtained by students for each course.

In addition to supplementary exams, remedial exams both individually and classically are held if the lecturer considers that students have not met the criteria for achieving course competencies. The re-examination can be considered as an effort to achieve the minimum assessment of the course graduation limit, which is a score of 56 (Academic Regulations 2019). In principle, examination services for students with disabilities are no different from other students. The study program policy is in the form of schedule arrangement and class use so that for classes with students with disabilities, the study program conditions the preparation of the exam schedule in a room that is easily accessible to students with disabilities.

The results of the final assessment of competency achievement by students in theory, practice and field courses are a combination of daily assessment results, midterm exam results, assignment assessment results, final semester exam results, and results from other agreed components. The results of the final assessment of competency achievement by students for field courses are calculated based on the assessment format prepared by the faculty, and related institutions (LPPM for Community Service Program assessment), The results of the final

assessment of competency achievement by students for the final thesis project are calculated based on the assessment format prepared by the faculty.

Student learning outcomes are given in the form of letter grades as a conversion grade reflecting the ability to achieve learning based on Peraturan Rektor No.1 Tahun 2019 concerning Peraturan Akademik 2019 article 21. In article 23, the academic regulation mandates that the determination of conversion grades is based on benchmark reference assessment (PAP) to ensure the quality of student learning outcomes in the course. Assessment reporting is a qualification of student success in taking a course expressed in letters as a conversion of the final grade. The conversion guidelines based on the 2019 UNY Academic Regulations are listed in Table 14.

Tabel 14. Conversion of final score to letter score

Final score	**Conversion**	
Scale of 100	Letter	Weight
86 – 100	A	4,00
81 – 85	A-	3,67
76 – 80	B+	3,33
71 – 75	B	3,00
66 – 70	B-	2,67
61 – 65	C+	2,33
56 – 60	C	2,00
41 – 55	D	1,00
0 – 40	E	0,00

The assessment results are announced to students through the university website at the end of each semester two weeks after all stages of the course examination are carried out. The results of the assessment of student learning achievements in each semester are stated with an achievement index (IP), and the results of the assessment of student learning achievements in all semesters taken and at the end of learning are stated with a cumulative achievement index (GPA). IP and GPA are expressed in the amount calculated by summing up the multiplication between the letter grade of each course taken and the credits of the relevant course divided by the number of credits of courses taken in the relevant period.

Students are declared to have graduated if they have taken the entire specified learning load and have the graduate learning outcomes targeted by the study program with a cumulative grade point average (GPA) greater than or equal to 2.00 (two point zero zero). Student graduation can be given a satisfactory, very satisfactory, or praise predicate with the criteria given in Table 15.

Table 15. Graduate predicate based on GPA

Criteria	GPA
Cumlaude	> 3,50
Very satisfactory	3.01 – 3.50
Satisfactory	2,76 – 3,00

H. Course Description

The description of each course in the Chemistry Study Program to achieve both the main PLOs and additional PLOs is presented in Tables 16 and 17.

Table 16. Description of Main Courses

No	Code		Course Name	Course Description
University Course (MKU) - Compulsory				
1	MKU	6201	Islamic Education	This course is carried out so that students have a complete personality (kaffah) by making Islamic teachings the basis for thinking and behaving, especially in scientific and professional development. A complete personality can only be realized by instilling faith and piety in Allah SWT. Building awareness that faith and piety will only be realized if supported by the development of its elements, namely: insight / knowledge about Islam (Islamic knowledge), religious attitudes (religious dispositions), skills in carrying out Islamic teachings (Islamic skills), commitment to Islam (Islamic commitment), confidence as a Muslim (moslem confidence), and proficiency in carrying out religious teachings (Islamic competence).
	MKU	6202	Catholic Education	The Catholic Religious Education course contains discussions on human beings and their origins, the vocation of human life, religious plurality and religious dialogue, Jesus proclaims the kingdom of God, Jesus completes His saving work, the Triune God, the Church comes from Jesus Christ and the mission of the church, Mary in salvation history, having faith in the context of the Republic of Indonesia and in the midst of advances in science and technology, Catholic marriage, social and moral problems as a challenge to faith.
	MKU	6203	Christian Education	The Christian Religious Education course provides spiritual provision for Christian students and spiritual direction in carrying out activities as students and humans who need to start to be able to live responsibly in a spiritual corridor.
	MKU	6204	Buddhist Education	The Buddhist Education course covers the basic concepts of Buddhism which include the substance of the study of Godhead, humans, law, morality, culture and science and technology, as an introduction to the personality of Buddhists.
	MKU	6205	Hinduism Education	The Hindu Religious Education course contains discussions on the introduction, the Supreme

				Godhead, human beings, law, ethics, science and art from a Hindu perspective, religious harmony, culture as an expression of Hindu religious experience, politics from a Hindu perspective, and leadership science.
	MKU	6206	Confucianism Education	The Confucian Religious Education course covers the urgency of religion in daily life with the right attitude. This course includes understanding the sources of Confucian law, knowing the history of Confucianism, being able to practice the Sacred Way brought by the Great Teachings (Thai Hak), and the role of Confucianism in the development of science and technology.
2	MKU	6207	Civic Education	Civic Education serves as an orientation for students in strengthening their insight and spirit of nationality, love for the country, democracy, legal awareness, respect for diversity and participation in building the nation based on Pancasila. In accordance with its function, Civic Education organizes nationality, democracy, law, multicultural and citizenship education for students to support the realization of citizens who are aware of their rights and obligations, as well as intelligent, skilled and character so that they can be relied upon to build the nation.
3	MKU	6208	Pancasila	This course provides a basic understanding of the basic concepts of Pancasila as the basis of state philosophy and all matters related to the existence and realization of Pancasila values in the life of the nation and state in every field of development. This course discusses Introduction to the Course, Pancasila in Studies, History of the Indonesian Nation, Pancasila as the State Foundation, Pancasila as a State Ideology, Pancasila Symbols, Pancasila as a Philosophical System, Pancasila as an Ethical System, and the Practice of Pancasila (Analysis of the essence of Pancasila).
4	MKU	6209	Bahasa Indonesia	The Indonesian language course contains teaching materials to improve students' ability to use good and correct Indonesian, both orally and in writing, especially in composing paragraphs, essays, academic writing, and presenting them accurately and politely.
5	MKU	6211	English	The English course is classified as a compulsory university course (MKU) which contains discussions to train four basic English skills namely reading, listening, speaking, and writing in the context of chemistry. This course is expected to equip students to be able to write and communicate scientifically

				using English, especially those related to the chemical context.
6	MKU	6212	Digital Transformation	The digital transformation course aims to introduce the era of the industrial revolution 4.0 which continues to transform from time to time with its utilization to support the field of science, especially in the field of chemistry. The digital transformation course will discuss the history of computers, the number system, computer language (pascal), the use of basic applications to create chemical compound structures through chemdraw and hyperchem, as well as data / word processing applications for research in the field of chemical computing. Lecture activities are carried out using a blended learning method that combines online learning and face-to-face learning. Evaluation of learning outcomes is based on several aspects, namely activeness, assignments, quizzes, UTS, and UAS with different weights.
7	MKU	6213	Creativity, Innovation and Entrepreneurship	This course aims to equip students: build entrepreneurial spirit and character, understand the concept of entrepreneurship, and train entrepreneurial skills. The material coverage of this course includes: development of entrepreneurial spirit and character, achievement motivation, creative thinking, the nature of entrepreneurship, business ethics and social responsibility, finding new ideas, production management, finance, marketing and human resources, business opportunities, business plan.
University Course (MKU) - Elective				
8	MKU	6216	Social Literacy and Humanity	This course discusses the existence of humans as cultural beings, civilized beings, individual beings and social beings, discusses humans in diversity, equality and dignity, humans in morality and law, humans with science and technology and humans with their environment. The purpose of the lecture is for students to develop into educated human beings who are critical, sensitive, and wise in understanding diversity, equality and human dignity based on aesthetic, ethical, and moral values in social life.
Faculty Course (FMI)				
9	FMI	6201		The Insights and Studies of Mathematics and Natural Sciences course is a faculty course with a weight of 2 credits. This course aims to provide students with insights into integrated MIPA science. This lecture covers the theory of how the integration of various

			Mathematics and Natural Sciences Insights and Studies	sciences for the benefit of the development of chemistry, including photosynthesis and food chains, philosophy of science, logic, decision-making principles, scientific methods, scientific attitudes and character building, the relationship of mathematics and science to other natural sciences, biological science and the integration of each system, and the role of MIPA in the development of research and technology. Learning activities are designed in a blended learning manner that combines face-to-face learning in the classroom and online learning with the help of besmart. The assessment of passing this course is based on several aspects, namely attitude, activeness, structured assignments, midterm exams, and final semester exams with different weights for each aspect.
10	FMI	6202	Statistics	The Statistics course is classified as a compulsory university course (MKU) which contains a discussion of the basic concepts of statistics, data description, probability, probability distribution, withdrawal distribution, examples of estimation, and hypothesis testing. This course is expected to equip students to be able to use and apply statistics in solving problems.
Main Chemistry Study Program Courses (MKPS)				
11	KIM	6401	General Chemistry	This course discusses atomic theory, periodic table of elements, chemical bonding, stoichiometry, introduction to chemical thermodynamics, chemical kinetics, chemical equilibrium, acid-base, colligative properties of solutions, and redox and electrochemical reactions. Lectures also study the application of basic chemical concepts in everyday life, and are followed by laboratory activities.
12	KIM	6202	Physics for Chemistry	The Physics for Chemistry course is a compulsory course for chemistry education majors, so chemistry study program students must take this course. This course contains theoretical and practicum subjects which include: Introduction to Physics and Measurement, Vector Analysis, Kinematics, Dynamics, Spring Constants and Forces, Heat, Coefficient of Long Expansion, Surface Tension of Liquid Substances, Fluid Mechanics, Static Equilibrium and Elasticity, Law I of Thermodynamics, Kinetic Theory of Gases and Law II of Thermodynamics.

13	KIM	6303	Mathematics for Chemistry	Mathematics for Chemistry is a compulsory course in the department, which is a chemical science course that equips students with mathematical concepts related to chemical problems, so that students think using mathematical flow so that they can solve chemical calculation problems in a structured, coherent and logical manner.
14	KIM	6404	Chemical equilibrium	Chemical Equilibrium course discusses the concept of gas and its properties, the first law of thermodynamics and its applications, thermochemistry, the second and third laws of thermodynamics and their applications, chemical equilibrium, phase balance, physical properties of solutions, and electrochemical equilibrium.
15	KIM	6405	Molecular Dynamics	This course studies molecular dynamics, which includes material on gas kinetics theory, molecules in motion (including gases and solutions), chemical reaction rates (including: empirical chemical kinetics and explanation of rate laws), and kinetics of complex reactions. The course includes theory and laboratory practicum.
16	KIM	6406	Fundamentals of Organic Chemistry	This lecture includes theory and practice which includes material 1). Basic concepts of organic reactions, namely organic molecular structure, resonance and conjugation. 2). structure, names, properties, reactions and conformations of alkane and cycloalkane compounds. 3). structure, names, properties and reactions of alkenes and alkynes compounds. 4). structure, names, properties and reactions of halo alkane compounds 5). structure, names, aromaticity and reactions of benzene compounds and their derivatives. 6). structure, names, properties and reactions of alkanol compounds, alkoxy alkanes, diols and thiols. 7). structure, names, properties and reactions of alkanal and alkanone compounds. 8). structure, names, properties and reactions of alkanoic acid compounds. 9). structure, names, properties and reactions of alkanoic acid derivative compounds. 10). structure, names, properties and reactions of nitrogen amine compounds.
17	KIM	6307	Structure and Reactivity of Organic Compounds	The structure and reactivity of organic compounds course contains concepts, structures, physical and chemical properties and reaction mechanisms in carbonyl compounds (aldehydes and ketones), amides, aromatic compounds, heterocyclic aromatics, stereochemistry, compounds with

				organic groups, carbohydrates, lipids, amino acids and proteins.
18	KIM	6308	Non-metal Inorganic Chemistry	This course includes theory and practice which includes: atomic structure of hydrogen, periodicity of elements, molecular structure (ionic and covalent bonds, Lewis structure), acid-base (Arrhenius, Bronsted-Lowry, Lewis, HSAB), chemical reactions (redox reactions, electrode potential, Latimer and Frost diagrams) and non-metallic main groups.
19	KIM	6409	Metal Inorganic Chemistry	Metal Inorganic Chemistry studies the concepts of metallic bonding, ionic bonding, properties, reactions and uses of alkali group metals, alkaline earth, aluminum, transition elements, tin and lead, iron corrosion and its prevention, reactions in various batteries.
20	KIM	6410	Fundamentals of Analytical Chemistry	The basics of analytical chemistry consist of Qualitative and Quantitative Analysis Chemistry. Qualitative analysis is the identification of sample components with specific reagents. Quantitative analysis is the determination of the amount (gram, percent) with volumetric techniques. Lectures emphasize the ability to master course material logically and scientifically and the ability to use scientific methods in solving problems faced by students.
21	KIM	6311	Chemical Separation Method	This course includes theory and practice which includes material on separation by distillation, separation by precipitation, solvent extraction, chromatography theory, gas chromatography, high performance liquid chromatography (HPLC), adsorption chromatography or solid liquid adsorption chromatography, partition chromatography or liquid-liquid chromatography, ion exchange chromatography, steric exclusion chromatography or gel permeation chromatography, thin layer chromatography and paper chromatography.
22	KIM	6412	Biochemistry	This course learns about the chemical structure, function, chemical processes in cells (the smallest part of living things) consisting of carbohydrates, fats, proteins, enzymes, minerals, vitamins and water in the chemical process (metabolism) of carbohydrates, lipids and proteins. The course also discusses nucleic acids, genetic engineering, hormones, nutrition and food, as well as practices on

				the properties and chemical reactions of carbohydrates, lipids, proteins and enzymes.
23	KIM	6213	Nuclear Chemistry	This course discusses changes in the structure of the nucleus due to reactions in the nucleus (nuclear reaction). Nuclear reactions consist of 2 (two) types, namely nuclear decay (radioactivity) and nuclear bombardment reactions. Lectures emphasize the ability to master course material logically and scientifically and the ability to use scientific methods in solving problems faced by students.
24	KIM	6214	Environmental Chemistry	This course provides experience for students to analyze chemical concepts related to the interaction of chemicals with biotic, abiotic, and social environments. The lecture material focuses on the sources, reactions, transportation, effects and fate of chemical species in the air, water and soil environments, as well as the influence of human activities on these processes. Lectures are conducted with discussions, demonstrations, and assignments that provide experience for students to solve environmental problems.
25	KIM	6215	Quantum Chemistry	The quantum chemistry course includes learning about basic concepts in quantum mechanics, the hydrogen atom, approximation methods, quantum chemical calculations, molecular orbitals and molecular structures and chemical reactions.
26	KIM	6216	Atomic and Molecular Spectroscopy	Concept of molecular symmetry, rotational spectroscopy, vibration, electronic transition spectroscopy, photoelectron spectroscopy, nuclear magnetic resonance, electron resonance and their applications in chemical systems.
27	KIM	6217	Colloidal and Surface Chemistry	Students are able to describe the structure of solid surfaces and examine its relationship with adsorption-desorption processes and mechanisms as well as surface analysis techniques. Students are also able to describe the properties of colloids and interfaces, emulsions and foams as well as factors that affect colloidal stability, and apply these concepts in several cases.
28	KIM	6218	Polymer chemistry	The course discusses the basic concepts of polymer science, polymerization reactions, polymer characterization, polymer properties and polymer development based on research that has been done.
29	KIM	6219	Physical Organic Chemistry	This Physical Organic Chemistry course covers the theory that includes stereochemical material, stereochemical reactions, types of organic chemical reactions (substitution, addition, elimination,

				molecular rearrangement, oxidation, reduction) and reactions in aromatic compounds.
30	KIM	6320	Determination of the structure of Organic Compounds	The Structural Analysis of organic chemical compounds course covers the basic concepts of spectroscopy, the basic principles of UV, IR, NMR, and MS spectroscopy, as well as the elucidation of the structure of organic compounds based on these spectroscopic data.
31	KIM	6221	Natural Products Chemistry	This course covers the classification, structure, properties, origin of biogenesis, biosynthesis, isolation, and identification of terpenoids, steroids, flavonoids, polyketides, polyphenols, alkaloids, and some examples of useful natural compounds found in various plant families.
32	KIM	6422	Coordination Chemistry	Coordination Inorganic Chemistry explains the typical properties of transition elements related to electronic configuration, oxidation state, formation of complex compounds, color, catalytic role, and magnetic properties, and understands the relationship of Russell-Saunders coupling with spectroscopic terms, limitations of complex compounds, types of ligands, coordination numbers, formula writing, naming, development of theoretical formulations of bonding in complex compounds according to the Blomstrand-Jorgensen chain model, and the Werner model, geometric shapes, and isomers of complex compounds, the concept of effective atomic number, and valence bond theory (VBT), crystal field theory (CFT), dia-/para-magnetic properties, high/low- spin, the magnitude of d orbital cleavage by the strength-weakness of the CFT model crystal field, molecular orbital theory (MOT); magnetic properties of dia-/para- magnetic, high/low- spin, and covalency level of MOT model, stability concept according to thermodynamic and kinetics aspects, mechanism of SN1-SN2 substitution reaction, trans effect, outside/inside-ball redox, and acid-base reaction of complex compounds, superconducting formula structure, electronic configurations typical for lanthanoid (4f) and actinide (5f) series, characteristics of stable oxidation levels, magnetic properties, lanthanoid contraction, difference between 4f orbitals and 5f orbitals.

33	KIM	6223	Crystallochemistry	Crystallochemistry courses are courses for students of Bachelor of Education in Chemistry with descriptions including: chemical structure description, symmetry and molecular groups, chemical bonds and lattice energy, molecular structures 1(compounds of the main group elements) and 2 (transition metal compounds), crystal gratings, symmetry and groups crystals, X-ray diffraction instruments and determination of simple crystal structures. This course aims to enable students to understand the structure and grid contained in molecular compounds 1 and 2.
34	KIM	6324	Chemical Instrumentation	This course includes theory and laboratory practice covering the scope of instrument chemistry, colorimetry, and various modern analytical methods such as UV-VIS spectrophotometry, FTIR, Mass, NMR, and SSA.
35	KIM	6225	Chemical Laboratory Management	This Chemistry Laboratory Management course studies the concepts and scope, procedures and laboratory management standards.
36	KIM	6226	Physical Biochemistry	Through this course, students are expected to be able to master the understanding and philosophy of biochemistry, the characteristics of life, the structure of living substances, energy transformation, and the history of physical biochemistry, energy metabolism, high-energy phosphate compounds (ATP), and the adenylate system controlling body metabolism, the mechanism of oxidative phosphorylation and the occurrence of a series of reactions in the body, the structure of proteins, biomembranes and their properties, and various kinds of transport systems in the body of living things.
37	KIM	6237	Fundamental of Computational Chemistry	This course discusses computational chemistry methods, the advantages and disadvantages of each computational chemistry method, as well as the application of modeling simple molecules This course includes learning about the basic concepts of computational chemistry concerning computational chemistry methods and their applications.
38	KIM	6228	Advanced of Computational Chemistry	The Computational Chemistry course includes learning about basic concepts in molecular mechanics and quantum mechanics and their applications, especially in studying the structure and dynamics of liquid systems (solvation), theoretical approaches such as HF (Hartree-Fock) theory, DFT (Density Functional Theory) and Force Field Method (Molecular Mechanics); In this lesson, we will learn / demonstrate the use of several computational chemistry software such as gaussian, turbomole, hyperchem and gromacs in solving

				chemical problems as well as interface programs such as gaussview, Tmolex and VMD in processing data simulation and modeling results.
39	KIM	6229	Molecular Biotechnology	This course discusses the definition of biotechnology, the history of biotechnology, and the manipulation of DNA technology. Mandaat and biotechnology applications.
40	KIM	6330	Chemical Research Methodology	The Chemistry Research Methods course contains topics: Research and Scientific Methods, Formulation of Background, problems and objectives Literature search and operational definition of variables, Selection of design / design design, Population and sample, Data measurement, Validity and reliability, Preparation of proposals, Writing reports and presentations of research results and Writing scientific publications.

Tabel 17. Deskripsi mata kuliah CP Utama Luar UNY/Lapangan

No	Code		Course Name	Course Description
1	MKL	6603	Internship	Internship courses equip students in providing an overview of the world of work in companies, industries, and research institutions. Through this course, students are expected to know the application of chemistry in various industrial activities and research institutions. The existence of this course can also increase the network of cooperation with companies, industries, or research institutions so that it is expected to increase the absorption of Chemistry study program alumni in the sector.
2	MKL	6604	Community Service	The Community Service course provides skills to students through direct experience and practice in the community. KKN field activities help students apply and integrate their knowledge in formulating problems and exploring the potential of an area based on science and technology. Students play an active role in moving with the community and mobilizing community participation as an effort to develop the potential of the region.
3	TAM	6801	Thesis	The Thesis course provides guidelines and benchmarks for students to carry out the basic concepts of research in accordance with their respective fields. Students are guided to be able to design, carry out, make reports, and defend their research in the thesis trial. Research design is carried out by preparing a research proposal which in the preparation process begins with a problem found through analysis of a certain condition that shows a gap between expectations and reality. The

				problems that arise must be overcome so that a solution is needed which begins with a literature review to get a good and appropriate solution. The solutions offered to overcome the problems that arise are carried out with appropriate research methods. The research data was collected through research instruments and then the data obtained was analyzed and then a report was made in the form of Final Thesis. The final thesis is prepared in accordance with the writing guidelines provided and is free from plagiarism.

Table 18. Course Description of Additional Chemistry Study Program Course

No	Code		Course name	Course description
MPKS Specialization in Renewable and Functional Materials				
1	KIM	6231	Chemical Application of Group Theory	Group Theory Chemistry explains the elements and symmetry operations, and their application in orbital objects and various chemical geometries, (4) the principal terms of a point group, and their application in determining the character of nondegenerate representations, matrices for degenerate representations to construct character tables, application of group theory in chemical bonding theory: hybridization models for various simple and complex molecules, application of group theory in chemical bonding theory: hybridization models for various simple and complex molecules, application of group theory in molecular orbitals for various simple and complex molecules, describe the application of group theory in crystal field theory related to the cleavage of d orbitals in the octahedron and tetrahedron fields.
2	KIM	6232	Inorganic Chemical Synthesis	This course studies inorganic chemical synthesis methods, high temperature synthesis, low temperature synthesis, hydrothermal and solvothermal synthesis, high pressure synthesis, photochemical synthesis, chemical deposition methods, chemical synthesis assisted by microwaves, synthesis of coordination compounds, fullerene synthesis, synthesis of organometallic compounds. , synthesis of nonstoichiometric compounds, and synthesis of ceramics.
3	KIM	6233	Solid Inorganic Chemistry	The Inorganic Chemistry of Solids course is a course for Bachelor of Chemical Education students with descriptions including: chemical description of the solid state, single crystals and polycrystalline,

				preparation of single crystals, synthesis and characterization of single crystals, physical characterization of solid materials, solid solutions, and crystal defects.
4	KIM	6234	Structural Analysis of Inorganic Compounds	This course deals with the description of inorganic materials using UV-Vis Spectrometer, FT-IR, X-ray Diffraction (XRD), and SEM instruments. The study focuses on the relationship between the structure and properties of inorganic salts, coordination compounds, aluminosilicate materials (zeolites, clays), and metal oxides.
5	KIM	6235	Nanochemistry Technology	This course discusses Nano Technology, NanoScience and Nanotechnology in Indonesia. The lectures also discuss Nanotools, Nanofabrication, Nanostructure Characterization, Nanostructure Materials, Nanoparticles and Nanocapsules. Through the Nanochemical Technology course, students are expected to understand the concepts in Nanotechnology and be able to apply these concepts in research.
6	KIM	6236	Bioinorganic	This course discusses the function and transport mechanism of metallic elements in physiological systems. The lectures enhance advanced knowledge to apply some basic concepts in coordination chemistry in predicting the function and reactivity of metal biomolecules based on their structure.
7	KIM	6237	Organometal	This course studies organometallic compounds, chemical compounds that contain at least one chemical bond between carbon atoms of organic molecules and metals, including alkali, alkali, and transition metals.
8	KIM	6238	Material Chemistry	This course addresses various aspects of chemistry in design and new discoveries as an important role for the synthesis of future functional materials. It advances the understanding of how the history of a material affects its structure, properties and performance. The course emphasizes the mastery of the course material in a logical and scientific manner and the ability to use the scientific method to solve problems encountered by students.

9	KIM	6239	Membrane Technology	Students are able to describe the understanding of membranes, membrane manufacturing, processes and how membranes work and their utilization.
10	KIM	6240	Catalyst Chemistry	Catalyst Chemistry course discusses the concept of catalysts, types of catalysts, synthesis, properties and applications in life.
MKPS Specialization in Biological Chemistry				
11	KIM	6241	Pharmaceutical chemistry	Learn about the basic concepts of the historical development of drugs, ways of administering drugs, Pharmacokinetic principles, pharmacodynamic principles, biopharmaceutical aspects of drugs, the main effects and side effects of drug use, Chemical structure of drug molecules, drug-receptor structure interactions and their biological activity, Relationship between drug structure and activity.
12	KIM	6242	Natural Products Chemistry	This lecture is an activity that broadens students' overall understanding of the basic concepts of food ingredients and chemical compounds related to food ingredients including moisture, carbohydrates, proteins, fats, minerals, vitamins, additives and contaminating elements, analysis of these chemical compounds in food ingredients and the latest food ingredient research trends. Lectures are conducted through inquiry and expository approaches through classical lectures, discussions, independent assignments and seminars using computer-assisted media.
13	KIM	6243	Synthetic Organic Chemistry	This lecture contains a discussion of the concepts of: principles of the disconnection approach; basic principles of aromatic compound synthesis; sequence of steps in the synthesis of organic compounds; disconnection of one C-X group: carbonyl compound derivatives RCO.X carboxylic acid derivatives, alcohol compounds, alkyl halides, sulfides, ethers; chemoselectivity; disconnection of two C-X groups: 1,1-difunctional compounds, 1,2-difunctional compounds, 1,3-difunctional compounds; synthesis of amines, protective groups.
14	KIM	6244	Isolation and Identification of Natural Material Compounds	This course discusses learning various isolation techniques and identifying the structure of organic compounds from natural materials, which include compound classes: terpenoids, steroids, flavonoids, polyketide, polyphenols, alkaloids, as well as several examples of useful natural compounds, found in the plant family. The lecture emphasizes the mastery of the lecture material in a logical and scientific manner and the ability to use the scientific method to solve problems faced by students.

15	KIM	6245	Organic Compound Reaction Mechanism	This course provides experience for students to study the factors that affect the mechanism of organic reactions, the mechanism of organic chemical reactions based on the structure and reactivity of functional groups, as well as the mechanism of radical reactions and their applications.
16	KIM	6246	Toxicology	This course studies the direction of toxicology, the general principles and mindset of toxicology, acute dose - chronic dose and dose response relationships, types of subject situations, toxicity, absorption, distribution, excretion, reactions occurring by conjugation reduction oxidation hydrolysis in air contaminants air contaminants and drugs, various types of toxicology, the use of toxicology.
17	KIM	6247	Enzymology	This course studies the structure and function of enzymes, understanding enzymes, enzyme classification and enzyme nomenclature, enzyme monomers and oligomers, factors that affect enzyme action, enzyme reaction kinetics: molecular mechanisms of enzymatic reactions, enzymatic reaction mechanisms without cofactors, enzyme involvement in enzymatic reactions, kinetics of enzymatic reactions with one substrate, relationship of initial reaction rate to concentration, inhibition, allosteric enzymes. Applications of enzymes in industry, isolation and purification of enzymes and immobilized enzymes.
18	KIM	6248	Petroleum Chemistry and Energy	The Petroleum Chemistry course explains to students the importance of petroleum mining and its products for life and human activities in general. This course explains the process of formation of petroleum, its processing into products that can be used. In addition, it also explains some petroleum products, including: how to make, chemical and physical properties, and quality benchmarks. In addition, this course also explains the pre-design stages of establishing a petroleum refinery industry.
19	KIM	6249	Fermentation Technology	The course discusses the development of fermentation technology, fermentation principles, behavior and metabolism of biological agents in fermentation, fermentation methods and kinetics, sterilization, and characteristics and handling of medium and inoculation and fermenters.
MKPS Specialization in Environmental Friendly Chemistry				
20	KIM	6250		The course will also include the study of electrochemical concepts and their applications in

			Electrochemical Analysis	analytical chemistry. These concepts include: Electrical energy chemical changes and electrolysis (redox reactants that require energy to occur), galvanic or voltaic cells (reactions that provide energy when they occur). Material coverage: 1. Electrolysis cell and galvanic cell 2. Potentiometry 3. Electrogravimetry 4. Polarography 5. Voltammetry
21	KIM	6251	Corrosion and Electroplating Chemistry	The Chemistry of Corrosion and Electroplating course discusses the concept of corrosion and its prevention, as well as electroplating and its uses.
22	KIM	6252	Industrial Materials Analysis	Introduction, Industry and Water, Steel Industry, Analysis of trace elements in minerals, Cement Industry, Paint Industry, Glass Industry and Ceramic Industry.
21	KIM	6253	Radioanalysis	This course discusses the chemical properties of radioactive nuclides, measurement of radioactivity, and their use in the analytical field. The subject of radio analysis includes the concept of radioactivity, measurement of radioactivity, hot atomic chemistry, application of radionuclides in the analytical field, application of radionuclides in engineering and industry.
22	KIM	6254	Management of hazardous wastes and toxic	This course provides experience for students to analyze the physico-chemical properties of hazardous waste and its management related to environmental health. The lecture material is focused on 1) Definition, nature, and classification of hazardous waste, 2) Regulations related to hazardous waste management, 3) Identification, documents, symbols, labels, packaging, storage, collection, transportation, processing, utilization, stockpiling and final disposal of hazardous waste, 4) Emergency response system in hazardous waste treatment, 5) Hospital waste treatment, 6) Chemical laboratory waste treatment, 7) Chemical industry waste treatment, 8) Printing waste treatment. Lectures are conducted with discussions, demonstrations, and assignments that provide experience for students to solve hazardous waste management problems.

23	KIM	6255	Surfactants and Additives	Students are able to describe the structure of surfactants and additives and examine their relationship with chemical processes and mechanisms as well as their application in daily life. Students are also able to describe the properties of surfactants in interfaces, as well as factors that affect their work process, and apply these concepts in several cases.
24	KIM	6256	Geochemistry	This course covers the theory that includes material; principles and history of geochemistry, earth and its relationship with the universe, structure and content of the earth, thermodynamics and crystal chemistry, magmatism and igneous rocks, precipitation and sedimentary rocks, and isotope geochemistry.

I. Contoh RPS (Rencana Pembelajaran Semester)

<table>
<tr><td colspan="2">UNIVERSITAS NEGERI YOGYAKARTA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
JURUSAN PENDIDIKAN KIMIA / PROGRAM STUDI KIMIA</td></tr>
<tr><td colspan="2">SEMESTER LESSON PLAN</td></tr>
<tr><td colspan="2">COURSE</td><td>CODE</td><td>COURSE GROUP</td><td>CREDITS</td><td>SEMESTER</td><td>CONSTRUCTION DATE</td></tr>
<tr><td colspan="2">Fundamentals of Analytical Chemistry</td><td>KIM6410</td><td>Analitical Chemistry</td><td>3 +1</td><td>3</td><td>6 Januari 2020</td></tr>
<tr><td colspan="2">OTORIZATION</td><td colspan="2">Lecturer</td><td colspan="2">Course Group Coordinator</td><td>Head of Department</td></tr>
<tr><td colspan="2"></td><td colspan="2">Sunarto, MSi</td><td colspan="2">Sunarto, MSi</td><td>Dr Retno Arianingrum</td></tr>
<tr><td rowspan="3">Program Learning Outcome (PLOs)</td><td>SP-PLOs</td><td colspan="5"></td></tr>
<tr><td>S</td><td colspan="5">S.8 internalizing academic values, norms, and ethics
S.9 demonstrating an attitude of responsibility for work in their field of expertise independently</td></tr>
<tr><td>P</td><td colspan="5">P.1 Able to use basic concepts of physics, biology, chemistry and mathematics to innovate in solving chemical problems
P.2 Able to master concepts, principles and skills in the field of chemistry which includes structure, dynamics, energetics, and measurement in depth which is oriented towards life skills
P.4 Able to master the principles of K3 (Occupational Safety and Security), laboratory management and the use of equipment and how to operate chemical instruments, as well as data analysis from these instruments</td></tr>
</table>

	KU	KU.2 able to demonstrate independent, quality, and measurable performance; KU.8 able to carry out a self-evaluation process of the work group under his responsibility, and able to manage learning independently
	KK	KK.1 Able to perform general and specific laboratory work, as well as synthesis and measurement techniques; KK.2 Able to systematically analyze various alternative solutions related to identification, analysis, isolation, transformation, and synthesis of simple chemicals. KK.3 Able to solve science and technology problems in the field of chemistry by applying relevant methods and technologies.
	CP - MK	
	M1	Identify sample components and determine their amount by volumetric analysis techniques.
Course Short Description	Basic Analytical Chemistry consists of Qualitative and Quantitative Analytical Chemistry. Qualitative analysis is the identification of sample components with specific reagents. Quantitative analysis is the determination of the amount (gram, percent) with volumetric techniques. Lectures emphasize the ability to master course material logically and scientifically and the ability to use scientific methods in solving problems faced by students.	
Learning Material/Subject Matter	Qualitative Analysis includes: Introduction (the nature of chemical analysis, types of chemical reactions, the role of chemical analysis, and steps in analysis), Properties of solutions, various concentrations of solutions and how to make them, Chemical equilibrium of solutions (acid-base equilibrium, complexes, redox and electrochemistry, precipitation), and Analysis of cations and anions. Quantitative Analysis includes: Gravimetry, Acid-base Titration, Complex Formation Titration, Oxidation-reduction Titration, Precipitation Titration. Also discussed are the accuracy, precision, and error of the analysis results as well as statistical tests on the analysis (t-test, one-way, two-way ANOVA).	
Reference	**Main**	
	1. I Made Sukarna (2007). Diktat Kimia Analisis 1. Analisis Kualitatif. Jurusan Pendidikan Kimia FMIPA UNY 2. Larry G. Hargis. 1988. A*nalytical Chemistry Principle and Techniques.* London: Practice Hall International Edition. 3. Sorum C.H. 1977. Introduction to Semimicro Qualitative Analysis. Fifth Edition. USA: Prentice Hall, INC	
	Additional	
	4. Bassett, at all. (Revisers). 1978. *Vogel's Text Book of Quantitative Inorganic Analysis. Including Elementary Instrumental Analysis.* Fourth Ed. London and New York: Longman. 5. Daniel C. Harris. 1987. *Quantitative Chemical Analysis.* New York: Freeman & Co.	

	6. Day, R.A, Underwood, A.L. 1989. *Analisis Kimia Kuantitatif. Edisi 5*. Jakarta : Erlangga 7. Garry D. Christian. 1977. *Analytical Chemistry*. New York : John Willey & Sons 8. Khopkar. S.M. 1990. *Konsep Dasar Kimia Analitik.* Cetakan I. Jakarta : UI Press. 9. Roekmini Sadli Soepa. 1980. Kimia Analisa I. Bandung : Departemen Kimia ITB.	
Learning Media	**Software**	**Hardware**
	PPT, Video (Virtual Lab)	Books, Laptop, Projector, White Board.
Team-Teaching	Drs, Sunarto, MSi Dra. Regina Tutik Padmaningrum, MSi	
Required Pra-Course	General Chemistry	

Learning Activities

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
1.	Explain the classification of chemical reactions. Determine the form of results in chemical reactions, the dissolution of substances with equilibrium theory. Taking sample for analysis	**Students able to:** - Conclude whether the cation-anion reaction takes place or not, by writing the reaction equation along with the phase of the substance. - Conclude whether a soluble substance can or cannot dissolve in dilute strong acid, using the equilibrium shift theory	Criteria: Accuracy in the use of statistical formulas Correctness of calculations. Originality of task completion. Form Assignment.	Discussion Presentation Individual Task	Reference 1	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
		- Can write the reaction equation for the formation of complex compounds and redox reactions and their equivalents.				
2.	Make various types of solutions with various concentration quantities (M, ppm, %, Normality (N))	**Students can:** - List the steps for making solutions with different types of concentrations. - Change one type of concentration to another type of concentration. - Can calculate the chemical count of solutions using Molarity and Normality.	Criteria: Accuracy and originality in providing the steps for making solutions with different types of concentrations, Accuracy in calculating the conversion of one type of concentration to another. Correctness in completing solution chemistry calculations Originality of task completion Assessment Type: Written Test Personal Work	Discussion Presentation Individual Task	Reference: 1	
3,4,5.	Understand chemical equilibrium in acid-base	**Students can:**	Criteria:	Discussion	Reference 1, 2	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
	reactions, complex ion formation reactions, redox reactions, and solubility reactions of soluble substances.	- Write the symbol of molar analytical concentration and equilibrium concentration. - Based on the Bronsted-Lowry acid-base dissociation equilibrium, can determine the relationship between Ka and Kb of conjugated acids, mention the species that play a role in determining the nature of the solution, and determine the pH of solutions and mixtures. - Mention the role of ligands in analytical chemistry. Mention the dominant EDTA ligand component on the effect of solution pH.	Accuracy, clarity, correctness, and originality in writing the concentration symbol, determining the relationship, determining the pH of the solution, mentioning the role of ligands, components of polyidentate ligands, determining the amount of analyte. From: Written test. Individual Work.	Presentation Individual Task		

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
		- Calculate the number of cations with reactions using a polyidentate ligand (EDTA), using relative concentration (α) and conditional equilibrium constant. - Explain the role of Ksp and conditional Ksp in the determination of solubility of insoluble substances				
6,7.	List the classification of cation analysis, preliminary analysis methods for both cation and anion analysis, and determine the types of cations and anions present in a sample.	**Students can:** - List the classification of cations on precipitating reagents. - List the preliminary analysis methods for cations. - Determine the cations present in a sample on the basis of reaction data with cation reagents in each class.	Criteria: Accuracy, originality of mention, determination. Completeness, originality of summary. Form: Written test. Assignment to make a summary	Discussion Presentation Individual Task	Reference: 1, 3.	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
		- Determine the anions present and absent in the sample with various reagents (concentrated sulfuric acid, hot concentrated sulfuric acid, silver nitrate solution and Barium chloride solution). - Mention how to analyze some anions with their respective specific reagents.				
8.	Midterm					40%
9.	Explain the formation of precipitates, choose precipitating reagents, calculate the number of analytes present in the sample by gravimetric method.	**Students can:** - List and explain the important stages of sediment formation (mechanism of precipitation). - Write down the gravimetric factor in determining the amount	Criteria: Accuracy, completeness, clarity and originality (with distinctive words) in explaining, mentioning, choosing Correctness and originality of gravimetric factor	Discussion Presentation Individual Task	Reference: 1, 2	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
		of an element or compound from its precipitate form. - Can select precipitating reagents (inorganic, organic) for certain elements. - Calculate the number of analytes using gravimetric techniques. - Write down the gravimetric factor in determining the amount of an element or compound from its precipitate form. - Can select precipitating reagents (inorganic, organic) for certain elements. - Calculating the amount of analyte by gravimetric technique	determination and calculation of the number of analytes in the sample. Form: Written test Home calculation assignment			

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
10,11.	Determine the right indicator in acid-base titration by making the titration curve, calculate the results of acid-base titration.	**Students can:** - Differentiate the equivalence point and end point of titration in volumetric analysis. - List the proper titration techniques. - List the conditions for reaction in volumetric analysis. - Classify the types of volumetric analysis based on the type of reaction. - List and explain various titration methods in relation to the calculation of the amount of analyte in the sample. - Make an acid-base titration curve - Determine the appropriate indicator used for acid-base	Criteria: Accuracy in the use of statistical formulas Correctness of calculations. Originality of task completion. Form Assignment.	Discussion (Problem Based Learning) Presentation Individual Task	Reference 1,2	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
		titration based on the titration curve. - Make standard solutions of acids or bases with certain concentrations, both primary and secondary standard solutions. - Determine the solution used for standardization of secondary standard solutions of acids or bases. - Calculating the amount of analyte by acid-base titration.				
12	Determine the total concentration of metal ions in complex formation with polyidentate ligands, calculate the amount of substances in the	**Mahasiswa dapat:** - Menghitung jumlah **konsentrasi ion logam (M^{n+}) dan pM^{n+}** menggunakan konsentrasi relatif (α) ion logam dan ligan, tetapan kesetimbangan	Criteria: Accuracy in the use of statistical formulas Correctness of calculations. Originality of task completion. Form	Discussion Presentation Individual Task	Reference: 1, 2	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
	sample by complex formation titration	pembentukan (K_f), dan tetapan kesetimbangan pembentukan bersyarat ($K_{M'Y'}$) untuk membuat kurve titrasi. - Menjelaskan secara **teori terjadinya perubahan warna indikator** pada titrasi pembentukan ion kompleks. - **Membuat larutan titran EDTA dan standarisasinya.** - **Menentukan jumlah ion logam dalam larutan** sampel dengan titrasi pembentukan kompleks menggunakan titran EDTA.	Assignment.			
13	Calculate the electrode potential of the solution, calculate the amount of analyte in the sample by	**Mahasiswa dapat:** - Menghitung **potensial elektrode larutan** (potensial elektrode	Criteria: Accuracy in the use of statistical formulas	Discussion Presentation	Reference: 1, 2	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
	various redox titration methods according to the type of titrant used.	yang dicelupkan ke dalam larutan relatif terhadap elektrode hidrogen standar) setiap penambahan volum titran untuk membuat Kurva titrasi. - Menentukan **indikator nonspesifik** yang dipakai pada titrasi redoks dengan berdasar kurve titrasi. - Menyebutkan **indikator spesifik** (indikator yang perubahan warna karena konsentrasi analit atau titran) yang biasa digunakan pada titrasi redoks. - Menyebutkan **zat pereduksi dan zat oksidator untuk keperluan prareduksi dan praoksidasi.**	Correctness of calculations. Originality of task completion. Form Assignment.	Individual Task		

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
		- Menyebutkan dan reaksi perubahan **titran oksidan dan titran reduktan** dalam titrasi redoks. - Menentukan **konsentrasi yang tepat dari titran oksidator dan reduktor dengan standardisasi** menggunakan zat tertentu. - Membedakan **titrasi iodometri dengan iodimetri**. - Menentukan **jumlah analit dalam sampel** dengan titrasi redoks.				
14.	Membedakan metode Mohr, metode Fajan, dan metode Volhard, menggunakan berbagai metode titrasi pengendapan untuk	**Mahasiswa dapat:** - Menghitung jumlah kation titran (Mn^{n+}) dan pM^{n+} yang ada dalam larutan setelah	Criteria: Accuracy in the use of statistical formulas Correctness of calculations.	Discussion Presentation	Reference 1,2	

Week No	Sub-PLO	Indicator	Criteria and Assessment Type	Learning Method (Time estimation)	Learning Materials (Reference)	Assessment Weight (%)
	menghitung jumlah analit dalam sampel.	penambahan sejumlah volume tertentu titran, guna pembuatan kurve titrasi (pM^{n+} vs volume titran). - Membedakan metode Mohr, metode Fajan, dan metode Volhard. - Menghitung jumlah analit dalam sampel dengan berbagai metode titrasi pengendapan.	Originality of task completion. Form Assignment.	Individual Task		
15.	Determine the accuracy, precision, and error of the analysis results, perform statistical tests on the analysis (t-test, one-way, two-way ANOVA).	**Students can:** - Determine the accuracy, precision and error of analysis results. - Conduct a test for the difference between two means and multiple means of significance	Criteria: Accuracy in the use of statistical formulas Correctness of calculations. Originality of task completion. Form Assignment.	Face-to-face lectures, questions and answers. Exercises Individual assignment	Data presentation and manipulation Reference 2	
16.	Final Exam (UAS)					50%

PENILAIAN

No.	Komponen Evaluasi	Bobot
1.	Assignment	10%
2.	Mid Term	40%
3.	Final Exam	50%
	Jumah	100%

Nilai Mahasiswa = $\frac{(Nilai\ Tugas\ x\ 10)+(Nilai\ UTS\ x\ 40)+(Nilai\ UAS\ x\ 50)}{100}$