FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS NEGERI YOGYAKARTA

CURRICULUM 2025

BACHELOR OF CHEMISTRY EDUCATION

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DEPARTEMENT CHEMISTRY EDUCATION
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS NEGERI YOGYAKARTA

DEAN'S WELCOME
Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta

Peace be upon you, and Allah's mercy and blessings,
Best wishes for all of us,

Alhamdulillah. All praise and gratitude we offer to the presence of Allah SWT, the Almighty God, for all His abundant grace and gifts, so that the preparation of the Academic Manuscript of the 2025 FMIPA UNY Curriculum can be completed well. This academic manuscript was compiled as a scientific and strategic foundation in the process of developing a curriculum that is adaptive to global and national dynamics. The development of the 2025 FMIPA Curriculum is the result of a comprehensive evaluation of the implementation of the 2020 Curriculum and refers to the National Standards for Higher Education, the Indonesian National Qualifications Framework (KKNI), Permendikbudristek 53 of 2023, and the need for future-oriented learning.

In line with the vision of Universitas Negeri Yogyakarta as a world-class educational university that is superior, creative, and sustainably innovative, as well as the vision of FMIPA as a superior, creative, and sustainably innovative faculty in mathematics, science, and technology education and science that is globally competitive, this academic paper serves as an important guideline in formulating a curriculum that not only answers the needs of the job market and the development of science and technology, but also forms graduates who are humanistic, ethical, and committed to sustainability.

The developed curriculum is based on the Outcome-Based Curriculum (OBC), which prioritizes the achievement of graduate learning outcomes through active, collaborative, interdisciplinary learning, and the use of digital technology. Aspects such as 21st-century life skills, innovation, entrepreneurship, biodiversity conservation, climate change, and inclusive education are also integrated to produce graduates who are not only academically competent but also adaptive, reflective, and transformative.

We extend our deepest appreciation to the entire drafting team, lecturers, and stakeholders who have contributed to the development of this curriculum's academic draft. We hope that the 2025 Academic Draft of the Faculty of Mathematics and Natural Sciences, UNY, will serve as a strategic foundation in preparing a future generation of learners and leaders with integrity, innovation, and resilience to face global challenges.

Peace be upon you and Allah be upon you.

Yogyakarta, June 16, 2025
Dean of the Faculty of Mathematics and Natural Sciences, UNY

FOREWORD TO THE STUDY PROGRAM

The development of science and technology, as well as social changes, must be part of the preparation of agents of change. The increasingly rapid development of computer and internet technology, coupled with the belief that students have the right to gain as much experience and expertise as possible, according to their talents and interests, has given rise to the concept of "independent learning and independent campus." To implement this concept, the Chemistry Education Study Program and all study programs at UNY have prepared a new curriculum, the Independent Learning and Independent Campus Curriculum (MBKM). This curriculum seeks to prepare graduates not only to master existing knowledge but also to equip them to become changemakers. Therefore, various curriculum evaluation efforts are being carried out to reflect on areas that have not been implemented in the previous curriculum and that need to be re-emphasized and summarized into a futuristic curriculum that allows students to pursue studies or gain experience outside their study program or outside the university, thereby meeting these challenges.

Therefore, with the hard work of all components of the academic community in the Chemistry Education Study Program coordinated by the curriculum development team, the MBKM Curriculum of the Chemistry Education Study Program can be compiled as a manifestation of shared ideals that are displayed in the vision and mission of the Chemistry Education Study Program. The central point of the entire curriculum is indeed realizing the vision and mission of the Chemistry Education Study Program, but this curriculum is developed from a further point, namely the KKNI, the vision and mission of Universitas Negeri Yogyakarta and the joint ideas of the Chemistry Education Division - Indonesian Chemists Association as stated in the Learning Outcomes of S1 Chemistry Education. Therefore, it is hoped that the MBKM Curriculum will answer national challenges so that alumni of the UNY Chemistry Education Study Program have provisions equivalent to alumni of the Chemistry Education Study Program in Indonesia with additional characteristics of the UNY Chemistry Education Study Program and are able to compete at the regional level.

The MBKM curriculum is the result of collaboration between all relevant stakeholders. More than that, it was made possible solely by the grace of Almighty God, the Almighty God, who continually provides strength and encouragement, and maintains the steadfastness of our shared ideals. Therefore, we express our gratitude to Him. We also extend our deepest gratitude to all those who assisted in the evaluation and development of the 2025 MBKM curriculum.

STUDY PROGRAM IDENTITY

Name of Study Program	:	Bachelor of Chemistry Education
Establishment Permit	:	1/DIKTI/Decree/1984
Accreditation Rating	:	Superior
Accreditation Certificate Number	:	154/SK/LAMDIK/Ak-I/S/VII/2022
head of the study program	:	Prof. Dr. Antuni Wiyarsi, M.Sc
Address	:	Jl. Colombo No. 01, Karangmalang, Caturtunggal, Depok, Sleman, Special Region of Yogyakarta, 55281

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INTRODUCTION

A. Background

Various disruptive and accelerating changes in the global context (Megatrend 2045, Industrial Revolution 5.0, SDGs, green economics, digital era, new generations); the regional context within the framework of the ASEAN Economic Community; the national context within the framework of national development towards Golden Indonesia 2045, as well as the local context within the framework of regional development priorities are very strong rationales for the need for curriculum adjustments. These changes have the consequence of requiring new human resource capabilities that are even very different from the capabilities of current human resources, including human resources graduates of higher education. Higher education is required to be able to produce graduates who excel in academic and scientific aspects, possess creativity and innovation, collaboration, problem solving, critical thinking, responsiveness, and adaptation to global challenges and have a commitment to ethical values and sustainability.

Universitas Negeri Yogyakarta (UNY) has a very strong commitment to producing high-quality graduates. This commitment is realized through the reconstruction of an adaptive, innovative, and collaborative curriculum; innovative learning and adaptive and comprehensive assessment. The expected curriculum is a curriculum that is more innovative, adaptive, flexible, and collaborative in line with the changing needs of future human resources. This aligns with the goal of education as a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have spiritual religious strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, the nation, and the state (Law Number 12 of 2012).

Curriculum Development at UNY in 2025 is carried out based on the results of a comprehensive evaluation of the implementation of the previous curriculum in line with various demands for change due to the rapid acceleration of change in various contexts. Curriculum development also refers to various changes in national regulations including: the Higher Education System Law, the Indonesian National Qualifications Framework, and the National Standards for Higher Education. Curriculum development also refers to the achievement of the vision and priority programs for university development. Curriculum Development is also carried out by taking into account the context of 21st Century Education by not only prioritizing mastery of scientific fields/expertise, but also instilling various skills as outlined in 21st Century Skills. The intended 21st Century Skills include life and career skills; learning and innovation skills; and information, media, and technology skills. Based on this, Curriculum Development is carried out with reference to the National Standards for Higher Education as stated in Permendikbudristek No. 53 of 2023 concerning Quality Assurance of Higher Education. The complete curriculum is compiled based on eight (8) National Education Standards which are further grouped into Output Standards, Process Standards and Content Standards.

The development of the 2025 Curriculum refers to the Indonesian National Qualifications Framework (KKNI), which contains nine (9) levels of competency qualifications. KKNI is a reference for comparing, equalizing, and integrating education, job training, and work experience, which are expressed in the formulation of learning outcomes. Curriculum development begins with establishing a graduate profile, which is elaborated into the formulation of Graduate Learning Outcomes (CPL). The formulation of abilities in the KKNI descriptor is expressed in terms of learning outcomes, while competencies are included in or are part of the learning outcomes (CP).

Government Regulation of the Republic of Indonesia Number 35 of 2022 concerning State Universities Legal Entity Universitas Negeri Yogyakarta sets out the vision of "Becoming a world-class educational university that is superior, creative, and sustainable innovative." In an effort to realize this vision, the UNY2025 Curriculum Development is carried out by integrating superior, creative, and sustainable innovative values in every stage of curriculum implementation. This vision is outlined in one of the missions, namely providing academic, vocational, and professional education for all levels that are superior, creative, innovative, and sustainable. In the context of realizing a world-class educational university, the 2025 Curriculum is designed to be able to produce graduates with character, adaptability, and success at the regional and international levels.

The 2025 Curriculum is designed with attention to scientific developments and new paradigms in higher education curriculum development. The Outcome-Based Curriculum (OBC), as part of the implementation of Outcome-Based Education (OBE), is a curriculum development paradigm used in

line with the 2024 Higher Education Curriculum Development Guidelines. Curriculum development based on the outcomes or learning outcomes of graduates is expected to be able to respond to the dynamics of human resource needs, government policies, and global issues in education. The 2025 Curriculum is expected to produce graduates who are not only superior in academic and professional aspects; but also collaborative, responsive, and adaptive to global and local challenges; and have a commitment to ethical values and sustainability.

B. Curriculum Development Foundation

The development of the Universitas Negeri Yogyakarta (UNY) curriculum is not only based on academic needs and the demands of the workplace, but also on various comprehensive and in-depth foundations. This development process refers to five main foundations: 1) Philosophical Foundation, 2) Sociological Foundation, 3) Psychological Foundation, 4) Historical Foundation, and 5) Legal Foundation, which serve as the basis for formulating a holistic curriculum that is relevant to various aspects of life.

1. Philosophical Basis

   Curriculum development is based on several philosophies such as humanism, essentialism, perennialism, idealism, and social reconstruction, emphasizing the educational philosophy implemented by UNY, namely "leading in character education based on Pancasila." The basis of this thinking includes:

   a. Indonesian people are creatures who learn and practice to acquire knowledge, skills, and form intelligent, intellectual, and independent attitudes.
   b. Education builds a complete Indonesian human being who is Pancasilaist; devout to God Almighty, humane, dignified, just, democratic, and upholds social values.
   c. Education equips students with progressive attitudes, knowledge, and skills so they can play a role and succeed in their lives.
   d. Education takes into account the characteristics and needs of students, the needs of society, advances in science and technology, and the culture of the Indonesian nation.
   e. Teachers have competencies including professional, personality, social and pedagogical competencies according to their field of expertise so that they can work professionally.

2. Sociological Foundation

   The sociological basis in curriculum development refers to social considerations that influence and shape the educational process.

   a. Responsive to Social Needs: The curriculum is designed to be responsive to evolving social needs, incorporating contemporary issues such as environmental sustainability, digital ethics, and social entrepreneurship into courses and other academic activities. This enables students to understand and provide solutions to existing social problems in society.
   b. Flexibility and Adaptability: Recognizing the diversity of student needs and backgrounds, the 2025 Curriculum provides flexibility in learning pathways through off-campus learning programs. Students can choose courses, internships, or social projects that align with their interests and career aspirations, allowing them to develop optimally within the social context.
   c. Social Character Building: The curriculum also emphasizes the importance of character building and social values, such as cooperation, leadership, tolerance, and social responsibility. Through specially designed co-curricular and extracurricular activities, students are encouraged to engage with their communities and develop a deeper understanding of their roles as active and responsible citizens.

3. Psychological Basis

   The psychological foundation is adapted to the principles of andragogy, namely an adult-centered learning method.

   a. Learning Theory and the Development of Thinking Aspects: refers to understanding how students acquire knowledge, skills, attitudes, or values through experience, instruction, or interaction with the environment. Students are encouraged to develop the ability to think more logically and abstractly, and to solve more complex problems over time based on the learning process.
   b. Emotions: Beyond Learning Theory and the development of thinking aspects, and understanding how emotions affect motivation, concentration, engagement, and information processing can help students manage emotions more effectively.
   c. Psychomotor: In disciplines that require practical and technical skills through practice, feedback, and repetition to help students become better prepared to apply their knowledge in real-world situations.

d. With learning theories and development of thinking, emotional, psychomotor aspects, and a flexible, innovative and responsive learning environment to student needs, it is oriented to produce graduates who not only have relevant knowledge and skills, but also have the ability to continue learning and adapting to face future challenges.

4. Historical Basis

The historical foundation is an important foothold that connects with current and future needs, including: (1) preparing students to become competent or superior educators and education personnel who are in line with the needs of educators and education personnel in Indonesia, (2) researching and developing educational science, and (3) carrying out community service, especially in the field of education.

a. Facilitating Learning in a Timely Manner: This encompasses an understanding of the latest technologies, social dynamics, and global challenges facing the 21st century. With a historical foundation, the curriculum not only reflects current developments but also integrates learning from the past, enabling students to understand how history has shaped the world today.
b. Passing on the Nation's Golden Cultural and Historical Values: Includes components that teach local, national, and global history and culture in a relevant and inspiring manner. Students are encouraged to study and appreciate the nation's rich historical heritage and understand its role and contribution to the development of global civilization.
c. Transforming History into a Modern Context: This encompasses efforts to transform the values and lessons of history into a modern learning context. This includes learning about successful strategies from the past that can be adapted to solve contemporary problems, as well as ethical and moral values that remain relevant.
d. Preparing Students for the Era of Industry 4.0 and Society 5.0: Producing graduates who are technically and professionally competent, but also individuals with a deep understanding of their historical and cultural heritage. This enables UNY graduates to not only adapt to changing times but also contribute significantly to shaping a better future, both locally and globally.

5. Legal Basis

a. Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers (State Gazette of the Republic of Indonesia 2005 Number 157, Supplement to the State Gazette of the Republic of Indonesia Number 4586);
b. Law of the Republic of Indonesia Number 12 of 2012 concerning Higher Education (State Gazette of the Republic of Indonesia 2012 Number 158, Supplement to the State Gazette of the Republic of Indonesia Number 5336);
c. Presidential Regulation of the Republic of Indonesia Number 8 of 2012, concerning the Indonesian National Qualifications Framework (KKNI);
d. Government Regulation Number 35 of 2022 concerning the Legal Entity Higher Education Institution of Universitas Negeri Yogyakarta;
e. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 73 of 2013, concerning the Implementation of the KKNI in the Higher Education Sector;
f. Regulation of the Minister of Education and Culture No. 7 of 2020 concerning the Establishment, Changes, Dissolution of State Universities, and the Establishment, Changes, and Revocation of Permits for Private Universities;
g. Regulation of the Minister of Education, Culture, Research, and Technology Number 6 of 2022 concerning Diplomas, Competency Certificates, Professional Certificates, Degrees, and Equivalence of Diplomas from Universities in Other Countries;
h. Regulation of the Minister of Education, Culture, Research, and Technology Number 13 of 2022 concerning Amendments to Regulation of the Minister of Education and Culture Number 22 of 2020 concerning the Strategic Plan of the Ministry of Education and Culture for 2020-2024;
i. Regulation of the Minister of Education, Culture, Research, and Technology No. 53 of 2023, concerning Quality Assurance of Higher Education;
j. Decree of the Minister of Research, Technology, and Higher Education No. 123 of 2019 concerning Internships and Recognition of Industrial Internship Semester Credit Units for Undergraduate and Applied Undergraduate Programs;
k. Rector's Regulation Number concerning Academic Guidelines of Universitas Negeri Yogyakarta;
l. UNY Chancellor Regulation Number 15 of 2023 concerning UNY Academic Regulations;

m. UNY Chancellor's Decree Number 682 concerning the Revision of the UNY Undergraduate Study Program Curriculum.
n. Regulation of the Chancellor of Universitas Negeri Yogyakarta Number 4 of 2025 concerning the Curriculum Development Guidelines of Universitas Negeri Yogyakarta

C. Vision, Mission, and Goals of the University and Faculty

UNY Vision

To become a world-class educational university that is superior, creative, and sustainably innovative.

UNY Mission

1. organizing superior, creative and innovative sustainable academic, vocational and professional education;
2. conducting research and development in the fields of science and technology, social humanities, sports-health, and arts and culture that is superior, creative, and innovative and sustainable;
3. organizing superior, creative and innovative community service activities that are sustainable for community empowerment and welfare;
4. organizing and building sustainable networks at national and international levels;
5. and organize transparent and accountable institutional governance, services and quality assurance.

UNY's Goals

1. produce graduates who are superior, creative, innovative, pious, independent and intellectual;
2. produce discoveries, developments and dissemination of science, technology, art and/or sports that improve the welfare of individuals and society, support regional and national development and contribute to solving global problems;
3. the implementation of community service and empowerment activities that encourage the development of human, community and natural potential to realize community welfare;
4. generate networks involving the community, academics, industry and media at national and international levels;
5. and produce transparent and accountable university governance in the implementation of higher education autonomy.

Vision of FMIPA

To become a Faculty that is Sustainably Superior, Creative, and Innovative in Mathematics, Science, and Technology Education and Science with Global Competitiveness

FMIPA Mission

1. Organizing education in the fields of mathematics, science and technology that is superior, creative, innovative, sustainable and globally competitive;
2. Conducting research and development in the fields of education and mathematics, science and technology that is superior, creative, innovative, sustainable and globally competitive;
3. Organizing community service activities in the fields of education and mathematics, science and technology that are superior, creative and innovative and sustainable for the empowerment and welfare of the community;
4. Organizing and building sustainable networks in the fields of education and mathematics, science and technology at the national and international levels; and
5. Organizing transparent and accountable institutional governance, services, and quality assurance at FMIPA UNY.

Objectives of FMIPA

1. Producing graduates in the fields of education and mathematics, science and technology who are superior, creative, innovative, pious, independent, intellectual and globally competitive.
2. Producing products and innovations in the fields of education and mathematics, science, and technology that improve the welfare of individuals and society to support regional and national development, and contribute to solving global problems.
3. The implementation of community service and empowerment activities in the fields of education and mathematics, science and technology which encourage the development of individual, community and natural potential to realize community welfare;
4. Producing a network of collaborative partners in the fields of education and mathematics, science and technology that is sustainable at the national and international levels; and
5. Producing effective, efficient, transparent and accountable governance in the implementation of the Tridharma of Higher Education at FMIPA UNY.

D. Stages of Curriculum Development

The curriculum development process begins with a needs analysis, which measures the achievement of the current curriculum's CPL (Competency Learning Outcomes) through tracer studies, and gathers input from graduate users, alumni, and experts in the field. Curriculum evaluation is also conducted by reviewing developments in science and technology in relevant fields, job market needs, and the vision and values developed. Furthermore, based on the graduate profile, Graduate Learning Outcomes (CPL), study materials, courses, and their credit weights, as well as the curriculum structure, are formulated.

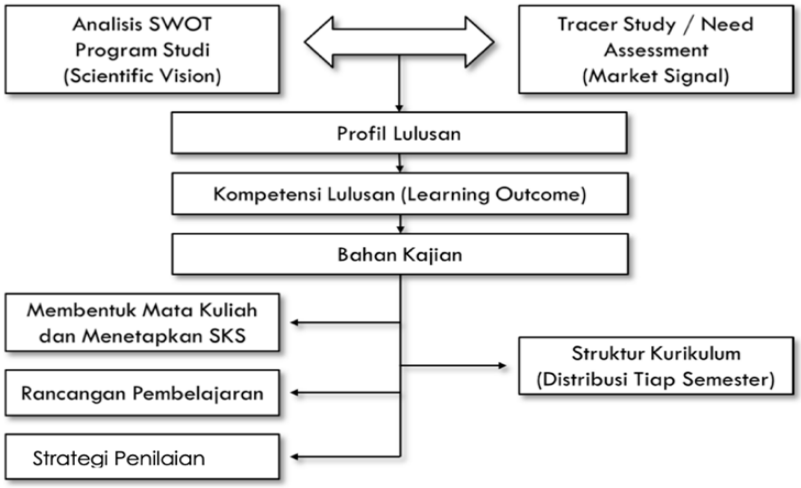

Figure 1. Stages of Curriculum Development

1. Determination of graduate profiles
   The profile is determined based on a study of job market needs, as required by the government, business, and industry, as well as the needs of developing science and technology. Graduate profiles for study programs are compiled by groups of similar study programs (prodi), resulting in a consensus that is acceptable and can be used as a national reference. To fulfill the roles outlined in the graduate profile, a description of the competencies is required, expressed in the formulation of Graduate Learning Outcomes (CPL).
2. Formulating Graduate Learning Outcomes (CPL)
   In accordance with Permendikbudristek No. 53 of 2023, the determination of CPL is formulated by integrating the values of attitudes, knowledge, and skills that indicate student achievements from learning outcomes at the end of the higher education program.
3. Determination of Study Materials
   The CPL formulated by the study program is integrated into the study materials used to develop the course. The study materials are then further elaborated into learning materials. The breadth and depth of the learning materials are based on the formulated CPL.
4. Formation of Courses and Determination of the Number of Credits.
   Each course, based on the established study program's CPL (learning material, assignment format, exam questions, and assessment), is assessed to determine how closely each course relates to the established CPL (learning material, assignment format, exam questions, and assessment). New courses are created based on several CPL points assigned to them. The factors determining the estimated credit weight include: the level of competency to be achieved; the depth and breadth of the learning material to be mastered; and the learning methods/strategies chosen to achieve these competencies.
5. Curriculum Structure Development
   The organization of courses within the curriculum structure is carried out carefully and systematically to ensure efficient and effective learning, leading to the achievement of the Study Program's CPL (Competency Level of Study). Furthermore, the curriculum structure ensures that students' learning stages are appropriate. The organization of courses within the curriculum structure consists of horizontal and vertical organization.

CPL1	CPL2	CPL3	CPL4	CPL5	CPL6	CPL7	…..	…..	CPLn

Smt	Cred	Num of MK	Undergraduate/Applied Undergraduate Study Program Course Group						
			MK-Mandatory					MK-Pil.	MKWU
				MK8a (2 credits)	TA/Thesis				
VII	**20**	**6**	MK7ua(4 credits) CPL1+CPL3+CPL6	MK7ub (4 credits)	MK7uc (4 credits)	MK7ud (4 credits)	MK7ue (4 credits)		MK7wu (2 credits)
VI	**20**	**6**	MK6ua (4 credits)	MK6ub (4 credits)	MK6uc (4 credits)	MK6ud (4 credits)		MK6ue (2 credits)	MK6wu (2 credits)
V	**20**	**5**	MK5ua (4 credits)	MK5ub (4 credits)	MK5uc (4 credits)	MK5ud (2 credits)		MK5ue (4 credits)	
IV	**20**	**6**	MK4ua (3 credits)	MK4ub (3 credits)	MK4uc (5 credits)	MK4ud (3 credits)		MK4ue (4 credits)	Religion (2 credits)
III	**20**	**6**	MK3ua (4 credits)	MK3ub (4 credits)	MK3uc (4 credits)	MK3ud (4 credits)	MK3ue (2 credits)		Indonesian (2 credits)
II	**18**	**6**	MK2ua (4 credits)	MK2ub (4 credits)	MK2uc (4 credits)	MK2ud (2 credits)	MK2ue (2 credits)		Citizenship (2 credits)
I	**18**	**5**	MK1ua (4 credits)	MK1ub (4 credits)	MK1uc (4 credits)	MK1ud (4 credits)			Pancasila (2 credits)
	144	**42**							

Organisasi Vertikal (kedalaman)

Organisasi Horizontal (keluasan)

Figure 2. Curriculum Structure Organization Matrix

The horizontal organization of courses within a semester is intended to expand students' discourse and skills within a broader context. The vertical organization of courses within a semester is intended to provide students with mastery of skills according to the level of learning difficulty to achieve the established CPL (Competency Level) of the study program.

6. Learning Process Planning

Learning process planning includes the formulation of: (a) learning outcomes that become learning objectives; (b) how to achieve learning objectives through learning strategies and methods; and (c) how to assess the achievement of learning outcomes. Implementation of the learning process is the implementation of learning activities in a structured manner in accordance with the direction of the lecturer and/or team of lecturers in charge with certain forms, strategies, and learning methods.

7. Learning Assessment Planning

Assessment of the learning process is carried out by lecturers and/or a team of lecturers in coordination with the study program management unit. Assessment of learning outcomes is carried out in a valid, reliable, transparent, accountable, fair, objective, and educational manner. Assessment of student learning outcomes takes the form of formative and summative assessments. Formative assessments aim to: (a) monitor student learning progress; (b) provide feedback so that students meet their learning outcomes; and (c) improve the learning process. Meanwhile, summative assessments aim to assess student learning outcomes as a basis for determining course completion and study program graduation, with reference to the fulfillment of graduate learning outcomes. Summative assessments are carried out in the form of written exams, oral exams, project assessments, assignment assessments, competency tests, and/or other similar forms of assessment.

CHEMISTRY EDUCATION STUDY PROGRAM CURRICULUM

A. Rational

Curriculum evaluation is a crucial part of higher education, ensuring that the curriculum remains relevant, effective, and aligned with student needs, the workplace, and scientific developments. Developments in science, technology, and the needs of the workplace are the first step in identifying the relevance of the current curriculum. If the curriculum is not aligned with these, a review is necessary to produce competitive, qualified graduates who are able to compete in today's global era. Furthermore, curriculum evaluation plays a role in improving the quality of ongoing learning by improving the methods, teaching materials, and assessments used to make them more effective than before. Identifying CPL achievement is also a factor in curriculum evaluation. Evaluation helps measure the extent to which graduates' learning outcomes align with established standards, both in terms of knowledge, skills, and professional attitudes. Therefore, curriculum evaluation aims to provide an overview of aspects of the curriculum that need improvement, such as gaps between theory and practice, mismatches between course load and expected competencies, or skills development that need to be added or enhanced.

The vision and mission of a higher education institution reflect a long-term orientation and commitment to the development of science and its contribution to society. In line with social, economic, and technological dynamics, universities need to adapt their vision and mission to remain relevant to global demands. Furthermore, the increasingly rapid development of science, technology, and the arts (IPTEKS) also impacts various aspects of life. Universities, as centers of scientific development, must be able to accommodate these changes in their curricula so that students receive a cutting-edge education that is relevant to the needs of industry and society. These two factors are fundamental to ensuring that the curriculum is able to meet the challenges of the times and the needs of society.

The change in status of Universitas Negeri Yogyakarta (UNY) to a State Legal Entity University (PTNBH) is a crucial factor driving the need for curriculum evaluation. As a PTNBH, UNY has greater autonomy in academic management, finances, and institutional governance. This provides the university with greater flexibility in designing a curriculum that adapts to the needs of industry, research, and community service. Consequently, the curriculum at UNY needs to be adjusted to be more oriented towards strengthening innovation, entrepreneurship, and global competitiveness. Curriculum evaluation within the PTNBH context also includes improving the quality of research-based learning, integrating digital skills into courses, and developing academic programs that support innovation and the downstreaming of research results. Furthermore, an interdisciplinary approach and flexibility in the development of elective courses are essential. With greater autonomy, the Bachelor of Chemistry Education study program is expected to develop a curriculum that is more responsive to the dynamics of science and technology, and facilitate collaboration with various stakeholders, including industry and international research institutions.

B. Evaluation and Tracer Study

The curriculum evaluation of the Undergraduate Chemistry Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta (FMIPA UNY) took place from February to March 2024. This evaluation involved various respondents, namely lecturers, students, and alumni, to obtain comprehensive insights regarding the effectiveness and relevance of the implemented curriculum. The instrument used in this evaluation was a curriculum evaluation questionnaire that was systematically designed to gather in-depth information regarding the implementation of the 2020 Curriculum in the Department of Chemistry Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta (FMIPA UNY). This evaluation covered various important aspects, such as the vision and mission of the study program, graduate profiles, Graduate Learning Outcomes (CPL), courses, learning descriptions, and the assessment system. The results of this evaluation are expected to serve as a basis for improving the curriculum to be more aligned with academic needs, scientific developments, and the demands of the workplace.

1. Curriculum Evaluation and Tracer Study Results

The results of this tracer study provide information on the journey of alumni of the UNY Chemistry Education Study Program after completing their education. In terms of funding, the majority of students, namely 63%, financed their education independently, while 30% received Smart Indonesia Card (KIP) or Bidikmisi scholarships, and 7% received scholarships from companies or private companies. No students received ADIK, PPA, or Affirmation scholarships. This data reflects that the majority of students are independent in financing their education, with scholarships being a supporting factor for the continuation

of their studies. Furthermore, in terms of career achievement, the majority of alumni have obtained jobs that are relevant to their fields of study.

Many alumni have pursued careers as educators, including teachers, tutors, and staff at the Department of Education. This demonstrates that the competencies acquired during their studies are highly relevant to the needs of the workplace. Furthermore, the academic experience, encompassing various learning methods, such as face-to-face lectures, demonstrations, research, internships, practicums, fieldwork, and discussions, is highly valued by alumni. These academic activities provide valuable insights and skills for facing professional challenges. However, the COVID-19 pandemic significantly impacted graduates in the 2019-2021 academic year, with the shift from face-to-face to online learning patterns leading to a decline in mastery of certain competencies. Some practical skills previously acquired through laboratory activities, practicums, and fieldwork became less than optimal, impacting graduates' readiness for the workforce. This impact is also reflected in alumni perceptions of UNY's contribution to shaping their competencies, which increased in the 2017-2019 period but declined in 2020-2021.

From the perspective of graduate users, UNY alumni are considered to possess a strong work ethic, appropriate professional competencies, and adequate skills in information and communication technology (ICT), teamwork, and self-development. This demonstrates that graduates possess not only academic abilities but also the social and professional skills needed in the workplace. However, several aspects still need improvement, particularly foreign language proficiency. Strong foreign language skills are essential in the era of globalization, both for accessing the latest scientific information and for expanding career opportunities internationally.

As part of efforts to align the curriculum with industry needs and developments in science and technology, input from lecturers, students, and alumni is a crucial component of curriculum evaluation. The following describes the evaluation results of each curriculum component by lecturers, students, and alumni of the Bachelor of Chemistry Education study program.

Table 1. Summary of Curriculum Evaluation and Tracer Study Results

Input Content	**Level of Importance**(v)					**Accepted**(v)	
	5	**4**	**3**	**2**	**1**	**Yes**	**No**
A. Input and Needs from the Community							
1. The formulation of the vision and mission of the study program in the old curriculum (2020) is still relevant to the formulation of the vision and mission of the faculty and university in 2025. However, innovation and utilization of technological developments in the digital era are needed.	√					√	
2. Several courses are needed to highlight the "uniqueness" of chemistry education. For example, religious and humanitarian values, cultural diversity, and citizenship can be made more efficient.	√					√	
B. Input and Needs from the World of Work/Industry							
1. Graduates are equipped with skills in laboratory and chemical waste management.	√					√	
C. Input and Needs from Alumni							
1. The vision and mission are still relevant, but they need improvement or adjustments, namely by broadening the scope (no longer just Southeast Asia) to the world. Furthermore, to align with the university's vision and mission, the slogan "devoted, independent, intellectual" should be omitted, but instead emphasize excellence, creativity, innovation, science, and technology, and sustainability.	√					√	
D. Input and Needs from Graduate Users							

Input Content	Level of Importance(v)					Accepted(v)	
	5	4	3	2	1	Yes	No
1. The profile of a "chemistry educator" is equipped to be a reliable and innovative educator in formal, informal, and non-formal institutions.	√					√	
2. Additional profiles can be formulated as chemistry curriculum developers and education management at the school level.	√					√	
E. Input and Requirements from the Government (Legal Regulations)							
1. For the revised curriculum, it is necessary to add the referenced regulations, namely Ministerial Regulation Number 53 of 2023 concerning Quality Assurance of Higher Education which includes National Standards for Higher Education.	√					√	
F. Input from the Accreditation Body							
1. The scientific vision is clarified so that it can demonstrate the excellence of the study program.	√					√	
G. Input and Needs from the Department							
1. There needs to be more clarity regarding the position of these Bachelor of Chemistry Education graduates, whether they are entitled to become chemistry educators, or are they only prospective PPG Chemistry students because they are not yet entitled to become chemistry educators.	√					√	
2. Adjust to the assessment guidelines at the university level.	√					√	
H. Input and Needs from Faculty							
1. The vision needs to be adjusted for the next 5 years, the sentence needs to be clarified, the order becomes "Excellent at the Southeast Asian level in the development of learning and research to produce Bachelor of Chemistry Education who fulfills pedagogical, professional, personality, social, globally competitive, creative, innovative, and has a pious, independent and intellectual character".	√					√	
I. Input and Needs from Universities							
1. The scientific vision and mission of the study program are adjusted to the new statutes of UNY PTNBH	√					√	

Description: 5 = very important, 4 = important, 3 = quite important, 2 = not important, 1 = very not important

2. Changes to Study Program Curriculum

The description of the curriculum changes can be summarized according to the curriculum components as follows.

Table 2. Dimensions of Change in Curriculum Evaluation and Tracer Study Results

Components of Change	2020 Curriculum	Curriculum 2025
1. Graduate profile	There are 2 main profiles: 1. Chemistry Educator 2. Chemistry Education Researcher There are 3 additional profiles: 1. Entrepreneur 2. Chemical Education Manager 3. Chemistry Research Assistant	Changes to the second main profile, to 'Beginner Researcher in Chemistry Education', because the term researcher is now directed towards professionals and for level 8
2. Vision and mission of the study program	Providing superior education, oriented towards science relevance, and technology-based through globally competitive chemical education research.	To become a superior, creative, and innovative undergraduate study program in Chemistry Education in learning and research of chemistry education oriented towards sustainable development based on technology to produce graduates who are adaptive, transformative, and globally competitive.
3. Graduate Learning Outcomes	There are 12 CPLs; consisting of 2 CPL attitudes, 4 CPL knowledge, 2 CPL general skills, and 4 CPL specific skills.	The number and distribution of CPL domains are the same, but there are more operational editorial improvements, as well as the addition of the element of 'honesty' to CPL 2 and 'communication skills' to CPL 8 to meet 21st century skills.
4. Curriculum structure and number of credits	There are three curriculum structure patterns that students can choose from according to MBKM provisions, namely the 5-1-2 pattern; 6-1-1; and 6-0-2, with a total of 150 credits that must be completed.	There is only 1 curriculum structure, with a total of 148 credits to be completed.
5. Types and Groups of Courses	There are 3 variations according to the pattern, with the standard pattern following the 6-1-1 ratio, for courses from the original study program, courses from outside the university, and additional courses from outside the study program. as follows; Courses from the study program of origin; 1. MKU/16 credits 2. MKF/4 credits 3. MKDK/8 credits 4. MKKPP/10 credits 5. MKPP/8 credits	There is only grouping of courses; 1. MKWK/8 credits 2. MKWU/6 credits 3. MKDK/10 credits MKWK and MKWU are divisions of the MKU in the previous curriculum, with several course changes. The courses in Digital Transformation, Creativity, Innovation, and Entrepreneurship, and Social and Humanitarian Literacy have been removed and replaced with Sports and Physical Fitness, and

	6. MKKPK/12 credits 7. MKKK/54 credits 8. MKPKPK/10 credits Courses from study programs outside the university; 9. MKLU/20 credits Additional courses outside the study program; 10. MKTLU/8 credits	Sustainable Education and Development..There is an additional MKDK course, namely Inclusive Education. 4. MKPKP/80 credits. This course is a combination of the MKKPK and MKKK courses in the previous curriculum. 5. MKF/4 credits. No course changes. 6. MKKPP/10 credits. No course changes. 7. MKPK/12 credits. 8. MKPLK/12 credits 9. MKTK/6 credits

C. Vision, Mission, and Objectives of the Study Program

1. Study Program's Scientific Vision

To become a superior, creative, and innovative undergraduate study program in Chemistry Education in learning and research of chemistry education oriented towards sustainable development based on technology to produce graduates who are adaptive, transformative, and globally competitive.

2. Study Program Mission

a. Organizing superior, creative and innovative education to produce graduates with pedagogical, professional, personality and social competencies.adaptive, transformative, and globally competitive.
b. Providing superior, creative, and innovative education to produce graduates with competencies in technology-based sustainable development-oriented educational learning and research.
c. Developing superior, creative and innovative research and scientific publications on chemistry education based on technology that is oriented towards sustainable development.
d. Carrying out community service activities that are superior, creative, innovative, oriented towards sustainable development, as well as being useful and effective for schools, communities and the industrial world.
e. Developing effective cooperation in the fields of education, research, community service and institutions at the local/regional, national, regional and international levels.
f. Organizing accountable and transparent governance of the undergraduate chemistry education study program based on the principles of collegiality and professionalism.

3. Study Program Objectives

a. Formulation of Study Program Objectives

The formulation of the objectives of the Bachelor of Chemistry Education Study Program is to mproduce graduates whoadaptive, transformative, and globally competitive, as demonstrated by:

TP1 : Able to become a chemistry educator who has pedagogical, professional, personality and social competencies.
TP2 : Able to become a novice researcher in the field of chemistry education that is oriented towards technology-based continuing education goals through innovations that are in line with current issues.
TP3 : Able to apply and develop an entrepreneurial spirit, especially in the field of chemistry and chemical education that is useful for oneself and society.
TP4 : Able to apply research skills in the field of chemistry that contribute to solving problems related to environmental issues and sustainable development goals by mastering chemical instrumentation.
TP 5: Able to collaborate and have a commitment to developing self-potential in order to develop professionalism in their field of work.

b. Alignment of Objectives with the Vision of the Study Program, Faculty, and University
The alignment between the study program objectives and the study program vision, faculty vision, and university vision is recorded as follows.

Table 3. Matrix of Conformity of Study Program Objectives (TP) with the Vision of the Higher Education Institution, Faculty, and Study Program

TP	UNY Vision			Vision of FMIPA			Scientific Vision of the Chemistry Education Study Program		
	superior	creative	Sustainable Innovation	superior	creative	Sustainable Innovation	Adaptive	Transformative	Global Competitiveness
TP 1	v			v			V		
TP 2		v	v		v	v	V		v
TP 3		v						v	v
TP 4							V		v
TP 5							V	v	

c. Alignment of Study Program Objectives with KKNI
Table 4. Alignment of the Chemistry Education Study Program Objectives with KKNI Level 6

KKNI Level 6 Descriptors	Study Program Objectives (TP)				
	TP1	TP2	TP3	TP4	TP5
Able to apply his/her field of expertise and utilize science and technology in his/her field in solving problems and able to adapt to the situations faced.	V			V	V
Mastering the theoretical concepts of a particular field of knowledge in general and the theoretical concepts of specific parts of that field of knowledge in depth, and being able to formulate solutions to procedural problems.	V	V		V	
Able to make the right decisions based on analysis of information and data, and able to provide guidance in selecting various alternative solutions independently and in groups.			V		V
Responsible for one's own work and can be given responsibility for achieving the organization's work results.	V				V

D. Graduate Profile

1. Graduate Profile and Profile Description

Table 5. Profile of graduates of the Chemistry Education Study Program, FMIPA UNY.

Graduate Profile	Profile Description
Main Profile	
Chemistry Educator	In this field, alumni of the Bachelor of Chemistry Education Study Program have been equipped to be able to become educators both in formal elementary and secondary education institutions, higher education, as well as informal and non-formal institutions, including as developers of chemistry curriculum and education management at the school level..
Beginning Researchers in Chemistry Education	In this field, alumni of the Undergraduate Chemistry Education Study Program, FMIPA UNY have been equipped to become novice researchers in the field of chemistry education that is

	oriented towards sustainable development goals by applying various educational research methods.
Additional Profile	
Education Manager	In this field, alumni of the Bachelor of Chemistry Education Study Program are equipped with educational management concepts and skills in designing learning programs in schools and educational activities in the community, laboratory management, and scientific extracurricular management in schools.
Entrepreneur	In this field, alumni of the Bachelor of Chemistry Education Study Program are equipped with the ability to develop themselves so they can become entrepreneurs, especially in the field of chemistry education or the field of chemistry.
Chemistry Research Assistant	In this field, alumni of the Bachelor of Chemistry Education Study Program are equipped with laboratory skills, designing experiments and carrying out simple chemical research to be able to act as assistants for chemical researchers or similar.

2. Compliance of Graduate Profile with Study Program Objectives

The suitability of the graduate profile with the objectives of the Chemistry Education Undergraduate Study Program is presented in Table 6.

Table 6. The Alignment of Graduate Profiles with the Objectives of the UNY Chemistry Education Study Program

Graduate Profile	TP 1	TP 2	TP 3	TP 4	TP 5
Chemistry Educator	V	V			V
Beginning Researchers in Chemistry Education		V		V	V
Education Manager	V		V		V
Entrepreneur			V	V	V
Chemistry Research Assistant		V		V	V

E. Graduate Learning Outcomes

1. Formulation of Learning Outcomes

Table 7. CPL Undergraduate Chemistry Education Study Program

CPL	CPL Formula
CPL1	Able to demonstrate religious spirit, morality, ethics and Indonesian character in group, social and national life.
CPL2	Able to demonstrate honesty, independence and responsibility in working individually and in groups in daily life and in society.
CPL3	Able to apply concepts, principles, laws, calculations and theories of chemistry, education, and chemistry education which is constantly updated as part of lifelong learning to solve problems in careers, daily life and social life based on religious values and national philosophy.
CPL4	Able to integrate chemical concepts, laboratory management and safety, chemical pedagogical knowledge, curriculum, strategies, learning resources, media, evaluation, classroom management, and ICT that support religious and philosophical values in chemistry learning activities.
CPL5	Able to apply chemistry education research methodology and characteristics of research procedures in supporting education programs for sustainable development and increasing the relevance of chemistry education to society as well as academic integrity in research and scientific work.
CPL6	Able to apply the concept of educational program management and entrepreneurship concepts in general as well as in the field of chemistry and chemical education.

CPL	CPL Formula
CPL7	Able to adapt critical and creative thinking skills, prevent plagiarism, and argue scientifically when facing problems in career, daily life and social life.
CPL8	Able to apply communication and collaborative skills to build networks, self-development, and solve problems in career, daily life and social life.
CPL9	Able to plan, manage, and evaluate chemistry learning in schools according to the characteristics of the material (content knowledge) and the characteristics of students, learning approaches, learning resources, learning media (pedagogical knowledge), and relevant information and communication technology (technological knowledge) in an innovative and adaptive manner.
CPL10	Able to plan, manage, and evaluate activities in the laboratory by paying attention to the principles of K3 (Occupational Safety and Security) and environmental issues in an innovative and adaptive manner.
CPL11	Able to identify problems and determine alternative solutions based on theories and research findings, design, implement them in chemical research and chemical education and publish them according to academic rules and integrity supported by the application of digital competencies.
CPL12	Able to communicate scientifically both orally and in writing to convey ideas or concepts in scientific forums using Indonesian and English to support sustainable development and increase the relevance of chemistry education to society.

2. Suitability of Graduate Learning Outcomes

The suitability of CPL with the Study Program Objectives can be presented in Table 8.

Table 8. Alignment between CPL and Study Program Objectives

Graduate Learning Outcomes (CPL)	TP 1	TP 2	TP 3	TP 4	TP 5
CPL1: Able to demonstrate religious spirit, morality, ethics and Indonesian character in group, social and national life.	V				V
CPL2: Able to demonstrate honesty, independence and responsibility in working individually and in groups in daily life and in society.	V				V
CPL3: Able to apply concepts, principles, laws, calculations and theories of chemistry, education, and chemistry education which is constantly updated as part of lifelong learning to solve problems in careers, daily life and social life based on religious values and national philosophy.	V				V
CPL4: Able to integrate chemical concepts, laboratory management and safety, chemical pedagogical knowledge, curriculum, strategies, learning resources, media, evaluation, classroom management, and ICT that support religious and philosophical values in chemistry learning activities.	V				V
CPL5: Able to apply chemistry education research methodology and the characteristics of research procedures in supporting education programs for sustainable development and increasing the relevance of chemistry education to society as well as academic integrity in research and scientific work.		V		V	
CPL6: Able to apply the concept of educational program management and			V		V

Graduate Learning Outcomes (CPL)	TP 1	TP 2	TP 3	TP 4	TP 5
entrepreneurship concepts in general and in the field of chemistry and chemical education.					
CPL7: Able to adapt critical and creative thinking skills, prevent plagiarism, and argue scientifically when facing problems in career, daily life and social life.	V				V
CPL8: Able to apply communication and collaborative skills to build networks, self-development, and solve problems in career, daily life and social life.	V		V		V
CPL9: Able to plan, manage, and evaluate chemistry learning in schools in accordance with the characteristics of the material (content knowledge) and the characteristics of students, learning approaches, learning resources, learning media (pedagogical knowledge), and relevant information and communication technology (technological knowledge) in an innovative and adaptive manner.		V		V	V
CPL10: Able to plan, manage, and evaluate activities in the laboratory by paying attention to the principles of K3 (Occupational Safety and Security) and environmental issues in an innovative and adaptive manner.		V			V
CPL11: Able to identify problems and determine alternative solutions based on theories and research findings, design, implement them in chemical research and chemical education and publish them according to academic rules and integrity supported by the application of digital competencies.		V			V
CPL12: Able to communicate scientifically both orally and in writing to convey ideas or concepts in scientific forums using Indonesian and English to support sustainable development and increase the relevance of chemistry education to society.	V			V	V

3. Alignment of Graduate Learning Outcomes with Graduate Profiles

The suitability of CPL with the graduate profile can be presented in Table 8.

Table 9. Table of Conformity between Graduate Learning Outcomes with Graduate Profile

Graduate Profile	CPL											
	1	2	3	4	5	6	7	8	9	10	11	12
Chemistry Educator	√	√	√	√				√	√	√	√	√
Beginning Researchers in Chemistry Education	√	√			√		√	√	√		√	√
Education Manager	√	√				√		√	√		√	√
Entrepreneur	√	√				√		√				√

Graduate Profile	CPL											
	1	2	3	4	5	6	7	8	9	10	11	12
Chemistry Research Assistant	√	√			√		√	√	√		√	√

F. Study Materials and Courses

The study materials developed refer to professional teacher competencies, namely personality, pedagogical, social, and professional competencies. The study materials are as follows.

1. The scope of knowledge related to the development of positive and religious personalities that can be role models in developing good relationships with students and understanding their needs to create a conducive learning environment.
2. The scope of science related to students' understanding of chemistry includes understanding chemical concepts and difficulties in understanding chemical concepts and developing strategies to overcome these difficulties.
3. The scope of science related to the chemistry curriculum used in schools includes objectives, content, structure, and evaluation as well as developing appropriate learning plans.
4. The scope of science related to chemistry learning strategies and representations through the use of various strategies and representations to help students understand chemical concepts.
5. The scope of science related to assessment includes how to assess students' mastery of chemistry and the development of valid and reliable assessment instruments to measure students' understanding.
6. The scope of science related to the orientation of science learning which includes philosophy, theory, approach, and psychology of learning including student development and thinking abilities.
7. The scope of science related to the development of collaborative skills between individuals and the community as well as the use of technology in learning to improve the quality of teaching and learning.
8. The scope of knowledge related to the skills of conveying ideas orally and in writing as research results in chemistry education, including methodology, implementation, and publication in accordance with academic ethics, both in Indonesian and English.

Table 10. Suitability of Graduate Learning Achievements, Study Materials, and Courses

Graduate Learning Outcomes (CPL)	Study Materials								
	BK1	**BK2**	**BK3**	**BK4**	**BK5**	**BK6**	**BK7a**	**BK7b**	**BK8**
CPL1: Able to demonstrate religious spirit, morality, ethics and Indonesian character in group, social and national life.	BK111: Religion (MWK60201-6) BK112: Pancasila (MWK60208) BK113: Physical Education (MWU60202)						BK171: Citizenship (MWK60207) BK172:ESD (MWU60203)		
CPL2: Able to demonstrate honesty, independence and responsibility in working individually and in groups in daily life and in society.	Independence Responsibility						Working in Groups: (MLK60601; MLK60605)		Interactions in School and Society (MLK60601; MLK60605)
CPL3: Able to apply concepts, principles, laws, calculations and theories of chemistry, education, and chemistry education which is constantly updated as part of lifelong learning to solve problems in careers, daily life and social life based on religious values and national philosophy.	Scientific Attitude	STEM: FMI60201 FMI60202 Basic Chemistry: SPK60401 Physical Chemistry: SPK60221 SPK60222 SPK60256 SPK60257 SPK60258 SPK60301	National and International Curriculum: SPK60243 Chemistry Curriculum: SPK60201 Learning Planning: SPK60213 SPK60214	Learning model: SPK60202 SPK60241 Special Topic Learning: MWP60205 SPK60211 SPK60230 SPK60206 SPK60207 SPK60208 SPK60209 SPK60210	Learning Assessment: SPK60238	Basic Science of Education: MWP60201 MWP60202 MWP60203 MWP60204 SPK60242		Instructional Media SPK60203 Technology in Learning: SPK60235 SPK60236 SPK60237	

Graduate Learning Outcomes (CPL)		Study Materials							
	BK1	BK2	BK3	BK4	BK5	BK6	BK7a	BK7b	BK8
		SPK60302 Inorganic Chemistry: SPK60224 SPK60306 SPK60307 Analytical Chemistry: SPK60308 SPK60309 SPK60310 SPK60225 SPK60284 SPK60285 SPK60286 Organic Chemistry & Biochemistry : SPK60303 SPK60304 SPK60305 SPK60223 SPK60264 SPK60265 SPK60266							

Graduate Learning Outcomes (CPL)		Study Materials							
	BK1	BK2	BK3	BK4	BK5	BK6	BK7a	BK7b	BK8
		Applied Chemistry: SPK60255 SPK60226							
CPL4: Able to integrate chemical concepts, laboratory management and safety, chemical pedagogical knowledge, curriculum, strategies, learning resources, media, evaluation, classroom management, and ICT that support religious and philosophical values in chemistry learning activities.	Scientific Attitude	Chemistry Lab: SPK60401 SPK60301 SPK60302 SPK60303 SPK60304 SPK60305 SPK60306 SPK60307 SPK60308 SPK60309 SPK60310	Lab Management SPK60244 SPK60213 SPK60227	Special Chemistry Topic Learning SPK60206 SPK60207 SPK60208 SPK60209 SPK60210 SPK60212 SPK60235 SPK60232				Technology in Learning: SPK60234	Learning Implementation: Micro Educational Practice: MLK60601
CPL5: Able to apply chemistry education research methodology and the characteristics of research procedures in supporting education programs for sustainable development and increasing the relevance of chemistry education to society as well as academic integrity in research and scientific work.									Educational Research: SPK60215
CPL6: Able to apply the concept of educational program management and entrepreneurship concepts in		Chemistry in Entrepreneurship		Chemistry in Entrepreneurship: SPK60228					

Graduate Learning Outcomes (CPL)		Study Materials							
	BK1	BK2	BK3	BK4	BK5	BK6	BK7a	BK7b	BK8
general and in the field of chemistry and chemical education.									
CPL7: Able to adapt critical and creative thinking skills, prevent plagiarism, and argue scientifically when facing problems in career, daily life and social life.						Thinking Skills: SPK60233	Cooperation		Publication: SPK60220
CPL8: Able to apply communication and collaborative skills to build networks, self-development, and solve problems in career, daily life and social life.							Field Lecture		Field Observation, Field data collection
CPL9: Able to plan, manage, and evaluate chemistry learning in schools in accordance with the characteristics of the material (content knowledge) and the characteristics of students, learning approaches, learning resources, learning media (pedagogical knowledge), and relevant information and communication technology (technological knowledge) in an innovative and adaptive manner.			Program Development (evaluation): SPK60214		Alternative assessment: SPK60238 SPK60239 SPK60240	Assessment and Evaluation			
CPL10: Able to plan, manage, and evaluate activities in the laboratory by paying attention				Lab Management			Group Research		Chemical Research SPK60229

Graduate Learning Outcomes (CPL)		Study Materials							
	BK1	BK2	BK3	BK4	BK5	BK6	BK7a	BK7b	BK8
to the principles of K3 (Occupational Safety and Security) and environmental issues in an innovative and adaptive manner.									
CPL11: Able to identify problems and determine alternative solutions based on theories and research findings, design, implement them in chemical research and chemical education and publish them according to academic rules and integrity supported by the application of digital competencies.		Preparation of Proposals and Research Plans: SPK60216 SPK60217							Educational Research: MKK60201 SPK60218 SPK60219 SPK60216 SPK60215 Preparation of proposals and research plans MKK60201 MKK60202 Research Instruments: SPK60216 SPK60217
CPL12: Able to communicate scientifically both orally and in writing to convey ideas or concepts in scientific forums using Indonesian and English to support sustainable development and increase the relevance of chemistry education to society.							Data Collection : MKK60801		Language: MWK60209 MWU60201 Communication SPK60220 Thesis :MKK60801

Table 11. Relationship Matrix between CPL, Courses and Credit Scores.

No	Code	Course Name	Percentage of Support for CPL												Course Description	Estimated Time	Number of credits
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	CPL 10	CPL 11	CPL 12			
1	MWK60201	Islamic education	20	2.5													2
	MWK60202	Catholic Religious Education															
	MWK60203	Protestant Christian Religious Education															
	MWK60204	Hindu Religious Education															
	MWK60205	Buddhist Religious Education															
	MWK60206	Confucian Religious Education															
	MWK60207	Civic education	20	2.5													2
2	MWK60208	Pancasila	20	2.5													2
3	MWK60209	Indonesian		2.5					20		4		12.5	6.25			2
4	MWU60201	English for Specific Purposes		2.5										18.75			2
5	MWU60202	Sports and Physical Fitness	10	2.5						4							2
6	MWU60203	Education and Sustainable Development	10	2.5	1	1											2
7	FMI60201	Insight into Mathematics and Natural Sciences Studies			1	7											2
8	FMI60202	Basic Statistics															
9	MKK60301	Research methodology			3	1							12.5				2
11	MKK60801	Thesis							20				12.5	12.5			2
12	MWP60201	Educational Science			3	1											2
13	MWP60202	Educational Psychology			3	1											2
14	MWP60203	Educational Management			3	1		10									2
15	MWP60204	Sociology and Anthropology of Education			3	1											2
16	MWP60205	Inclusive Education			3	1					4						2
17	SPK60201	Chemistry Curriculum and Learning			3	1											2

No	Code	Course Name	Percentage of Support for CPL												Course Description	Estimated Time	Number of credits
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	CPL 10	CPL 11	CPL 12			
18	SPK60202	Chemistry Learning Model			3	1											2
19	SPK60203	Chemistry Learning Media and Resources			3	1											2
20	SPK60204	Chemistry Learning Assessment			3	1					4						2
21	SPK60205	Chemistry Micro Learning		2.5		7						7					2
22	MLK60601	Educational Practice		10			10		10			15					2
23	MLK60605	Community Service Program (KKN)		10				10		20	4						6
24	SPK60206	Learning Structure, Chemical Bonding, and Stoichiometry															
25	SPK60207	Chemical Kinetics and Thermodynamics Learning			1	7				4	4	7					2
26	SPK60208	Learning Solution Chemistry			3		30			4	4			6.25			2
27	SPK60209	Redox and Electrochemistry Learning			1	7				4	4	7					2
28	SPK60210	Hydrocarbon and Macromolecular Learning		2.5					20				25	18.75			2
29	SPK60211	Chemistry Learning in Vocational Schools			3	1					4						2
30	SPK60212	Chemistry Learning for Continuing Education		2.5	3	7				4	4	7					2
31	SPK60213	Environmentally Friendly Chemistry Experiment Design			1	7				4	4	7					2
32	SPK60214	Chemistry Learning Program Development			1	7				4	4	7					2
33	SPK60215	Chemistry Learning Research Study			3	1											3
34	SPK60216	Chemistry Education Research Instruments			3	7						7					2
35	SPK60217	Analysis of Chemical Education Research Data		2.5			30										2

No	Code	Course Name	Percentage of Support for CPL												Course Description	Estimated Time	Number of credits
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	CPL 10	CPL 11	CPL 12			
36	SPK60218	Qualitative Research on Chemistry Education		2.5			30										2
37	SPK60219	Chemistry Education Seminar		2.5						4							2
38	SPK60220	Scientific Publication of Chemistry Education		10				10		20							6
39	SPK60401	Basic Chemistry			3	1											4
40	SPK60221	Mathematics for Chemistry			3												2
41	SPK60222	Fundamentals of Computational Chemistry			3	1											2
42	SPK60301	Chemical Equilibrium			3	1											3
43	SPK60302	Molecular Dynamics			3	1											3
44	SPK60303	Basic Organic Chemistry			3	1											3
45	SPK60304	Structure of Polyfunctional Organic Compounds			3	1											3
46	SPK60223	Determination of the Structure of Organic Compounds		2.5		1		10			20						2
47	SPK60305	Biochemistry			3	1											2
48	SPK60306	Structure of Inorganic Compounds			3	1											3
49	SPK60307	Basics of Inorganic Reactions			3	1											3
50	SPK60224	Coordination and Organometallic Chemistry			3	1											2
51	SPK60308	Fundamentals of Analytical Chemistry			3	1											3
52	SPK60309	Chemical Separation Methods			3	1											3
53	SPK60310	Chemical Instrumentation															
54	SPK60225	Environmental Chemistry		10						4	20						2
55	SPK60226	Applied Chemical Technology		2.5	3	7				4	4	7					2
56	SPK60227	School Chemistry Laboratory Management		2.5	3	1					4	15					2

No	Code	Course Name	Percentage of Support for CPL												Course Description	Estimated Time	Number of credits
			CPL 1	CPL 2	CPL 3	CPL 4	CPL 5	CPL 6	CPL 7	CPL 8	CPL 9	CPL 10	CPL 11	CPL 12			
57	SPK60228	Chemistry-Based Entrepreneurship	10	2.5				50		4							2
58	SPK60229	Chemical Research		2.5						4							2
59		MK Elective Education 1		10				10	30	4	4	7	37.5	18.75			8
60		MK Elective Education 2		2.5	1	1											2
61		Chemistry Elective Course		2.5	1	1											2
				2.5	1	1											2
			100	100	100	100	100	100	100	100	100	100	100	100			147

G. Curriculum Structure and Course Distribution

1. Curriculum Structure of the Bachelor of Chemistry Education Study Program

Table 12. Course Groups and Credits for the Bachelor of Chemistry Education Study Program

No	Subject	Number of credits Total	Number of Courses
1.	Compulsory Curriculum Courses (MKWK)	8	4
2.	Compulsory University Courses (MKWU)	6	3
3.	Faculty Courses (MKF)	4	2
4	Scientific Development Course (MKPK)	11	2
5.	Basic Education Course (MKDK)	10	5
6.	Learning Process Skills Course (MKKPP)	10	5
7.	Off-Campus Learning Courses (MKPLK)	12	2
8.	Study Program Scientific Foundation Course (MKPKP)	82	35
9.	Additional Competency Courses (MKTK)	6	3(25)
Total Credits		149	62

Table 13. Compulsory Curriculum Courses (MKWK)

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MWK60201	Islamic education	2			2	
	MWK60202	Catholic Religious Education					
	MWK60203	Protestant Christian Religious Education					
	MWK60204	Hindu Religious Education					
	MWK60205	Buddhist Religious Education					
	MWK60206	Confucian Religious Education					
2	MWK60207	Civic education	2			2	
3	MWK60208	Pancasila	2			2	
4	MWK60209	Indonesian	2			2	

Table 14. Compulsory University Courses (MKWU)

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MWU60201	English for Specific Purposes	2			2	
2	MWU60202	Sports and Physical Fitness	2			2	
3	MWU60203	Education and Sustainable Development	2			2	

Table 15. Faculty Courses (MKF)

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	FMI60201	Insight into Mathematics and Natural Sciences Studies	2			2	
2	FMI60202	Basic Statistics	2			2	

Table 16. Scientific Development Courses (MKPK)

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MKK60301	Research methodology	3			3	
2	MKK60801	Thesis		8		8	MKK 60202

Table 17. Basic Education Courses (MKDK)

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MWP60201	Educational Science	2			2	
2	MWP60202	Educational Psychology	2			2	
3	MWP60203	Educational Management	2			2	

4	MWP60204	Sociology and Anthropology of Education	2			2	
5	MWP60205	Inclusive Education	2			2	

Table 18. Learning Process Skills Courses (MKKPP)

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	SPK60201	Chemistry Curriculum and Learning	2			2	
2	SPK60202	Chemistry Learning Model	2			2	
3	SPK60203	Chemistry Learning Media and Resources	2			2	
4	SPK60204	Chemistry Learning Assessment	2			2	
5	SPK60205	Chemistry Micro Learning		2		2	SPK60214

Table 19. Off-Campus Learning Courses (MKPLK)

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MLK60601	Educational Practice			6	6	SPK60205
2	MLK60605	Community Service Program (KKN)			6	6	

Table 20. Study Program Scientific Foundation Courses (MKPKP)

No	Code	Course Name	T	P	L	Amount	Prerequisite
Foundations of Chemistry Education Course							
1	SPK60206	Learning Structure, Chemical Bonding, and Stoichiometry	2			2	SPK60401
2	SPK60207	Chemical Kinetics and Thermodynamics Learning	2			2	
3	SPK60208	Learning Solution Chemistry	2			2	
4	SPK60209	Redox and Electrochemistry Learning	2			2	
5	SPK60210	Learning Carbon and Macromolecular Chemistry	2			2	
6	SPK60211	Chemistry Learning in Vocational Schools	2			2	
7	SPK60212	Chemistry Learning for Continuing Education	2			2	
8	SPK60213	Environmentally Friendly Chemistry Experiment Design	2			2	SPK60212
9	SPK60214	Chemistry Learning Program Development		2		2	
10	SPK60215	Chemistry Learning Research Study	2			2	
11	SPK60216	Chemistry Education Research Instruments		2		2	MKK60301
12	SPK60217	Analysis of Chemistry Education Research Data	2			2	FMI60202
13	SPK60218	Qualitative Research on Chemistry Education	2			2	MKK60301
14	SPK60219	Chemistry Education Seminar	2			2	MKK60301

15	SPK60220	Scientific Publication of Chemistry Education		2		2	SPK60219
Chemistry Scientific Development Course							
16	SPK60401	Basic Chemistry	3	1		4	
17	SPK60221	Mathematics for Chemistry	2			2	
18	SPK60222	Fundamentals of Computational Chemistry	2			2	
19	SPK60301	Chemical Equilibrium	2	1		3	SPK60401
20	SPK60302	Molecular Dynamics	2	1		3	SPK60301
21	SPK60303	Basic Organic Chemistry	2	1		3	
22	SPK60304	Structure of Polyfunctional Organic Compounds	2	1		3	
23	SPK60223	Determination of the Structure of Organic Compounds	2			2	
24	SPK60305	Biochemistry	2	1		3	
25	SPK60306	Structure of Inorganic Compounds	2	1		3	
26	SPK60307	Basics of Inorganic Reactions	2	1		3	
27	SPK60224	Coordination and Organometallic Chemistry	2			2	
28	SPK60308	Fundamentals of Analytical Chemistry	2	1		3	
29	SPK60309	Chemical Separation Methods	2	1		3	
30	SPK60310	Chemical Instrumentation	2	1		3	
31	SPK60225	Environmental Chemistry	2			2	
32	SPK60226	Applied Chemical Technology	2			2	
33	SPK60227	School Chemistry Laboratory Management	2			2	
34	SPK60228	Chemistry-Based Entrepreneurship		2		2	
35	SPK60229	Chemical Research		2		2	SPK60310
		Number of MKPKP credits				**82**	

Table 21. Additional Competency Courses (MKTK)

No	Code	Course Name	T	P	L	Amount	Semester	
							Gs	Mount
Additional Courses in Chemistry Education Competencies*								
1	SPK60230	Trends in Chemistry Learning Strategies	2			2		√
2	SPK60231	Culture-Based Chemistry Learning	2			2		√
3	SPK60232	*Socio-scientific Issues*in Chemistry Learning	2			2	√	
4	SPK60233	Thinking Strategies in Chemistry Learning	2			2	√	
5	SPK60234	Chemical Modeling for Learning	2			2		√
6	SPK60235	Development of Electronic Chemistry Learning Resources	2			2		√
7	SPK60236	Educational Games in Chemistry Learning	2			2	√	

8	SPK60237	Social Media in Chemistry Learning	2			2	√	
9	SPK60238	Diagnostic Tests in Chemistry Learning	2			2		√
10	SPK60239	Multimodality in Chemistry Learning Assessment	2			2		√
11	SPK60240	Chemistry Project Based Assessment	2			2	√	
12	SPK60241	History and Perspectives of Chemistry	2			2	√	
13	SPK60242	Chemistry Teacher Professional Development	2			2		√
14	SPK60243	Review of the international chemistry curriculum	2			2		√
15	SPK60244	Management of Scientific Extracurricular Activities in Schools	2			2	√	
Additional Chemistry Competency Course**								
16	SPK60245	Nuclear Chemistry and Radiochemistry	2			2	√	
17	SPK60246	Colloidal Chemistry and Surfactants	2			2	√	
18	SPK60247	Membrane Technology	2			2	√	
19	SPK60248	Nanochemical Technology	2			2	√	
20	SPK60249	Polymer Chemistry	2			2	√	
21	SPK60250	Industrial Chemistry	2			2	√	
22	SPK60251	Pharmaceutical Chemistry	2			2	√	
23	SPK60252	Natural Material Chemistry	2			2	√	
24	SPK60253	Food Material Analysis	2			2	√	
25	SPK60254	Chemical Waste Management	2			2	√	

**Students choose courses according to their interests, minimum 4 credits*
***Students choose courses according to their interests, minimum 2 credits*

2. Distribution of Courses per Semester

Semester 1

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MWK60201	Islamic education	2			2	
	MWK60202	Catholic Religious Education					
	MWK60203	Protestant Christian Religious Education					
	MWK60204	Hindu Religious Education					
	MWK60205	Buddhist Religious Education					
	MWK60206	Confucian Religious Education					
2	MWK60207	Civic education	2			2	
3	MWU60201	English for Specific Purposes	2			2	
4	MWU60203	Education and Sustainable Development	2			2	
5	MWP60201	Educational Science	2			2	
6	MWP60202	Educational Psychology	2			2	
7	MWP60204	Sociology and Anthropology of Education	2			2	
8	FMI60201	Insight into Mathematics and Natural Sciences Studies	2			2	
9	SPK60401	Basic Chemistry	3	1		4	
		Number of credits	**19**	**1**		**20**	

Semester 2

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MWK60208	Pancasila	2			2	
2	MWU60202	Sports and Physical Fitness	2			2	
3	MWP60203	Educational Management	2			2	
4	MWP60205	Inclusive Education	2			2	
5	SPK60201	Chemistry Curriculum and Learning	2			2	
6	SPK60203	Chemistry Learning Media and Resources	2			2	
7	SPK60221	Mathematics for Chemistry	2			2	
8	SPK60306	Structure of Inorganic Compounds	2	1		3	
9	SPK60308	Fundamentals of Analytical Chemistry	2	1		3	
		Number of credits	**18**	**2**		**20**	

Semester 3

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	SPK60202	Chemistry Learning Model	2			2	
2	SPK60204	Chemistry Learning Assessment	2			2	
3	SPK60206	Learning Structure, Chemical Bonding, and Stoichiometry	2			2	
4	SPK60211	LearningChemistry in Vocational School	2			2	
5	SPK60222	Fundamentals of Computational Chemistry	2			2	
6	SPK60301	Chemical Equilibrium	2	1		3	
7	SPK60303	Basic Organic Chemistry	2	1		3	
8	SPK60307	Basics of Inorganic Reactions	2	1		3	
9	SPK60227	School Chemistry Laboratory Management	2			2	
		Number of credits	**18**	**3**		**21**	

Semester 4

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	SPK60207	Chemical Kinetics and Thermodynamics Learning	2			2	
2	SPK60208	Learning Solution Chemistry	2			2	
3	SPK60212	Chemistry Learning for Continuing Education	2			2	
4	SPK60302	Molecular Dynamics	2	1		3	
5	SPK60304	Structure of Polyfunctional Organic Compounds	2	1		3	
6	SPK60224	Coordination and Organometallic Chemistry	2			2	
7	SPK60309	Chemical Separation Methods	2	1		3	
8	SPK60226	Applied Chemical Technology	2			2	
9	SPK60228	Chemistry-Based Entrepreneurship		2		2	

10		MK Additional Educational Competency 1	2			2	
		Number of credits	**18**	**5**		**23**	

Semester 5

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	FMI60202	Basic Statistics	2			2	
2	MKK60301	Research methodology	3			3	
3	SPK60209	Redox and Electrochemistry Learning	2			2	
4	SPK60214	Chemistry Learning Program Development		2		2	
5	SPK60215	Chemistry Learning Research Study	2			2	
6	SPK60223	Determination of the Structure of Organic Compounds	2			2	
7	SPK60225	Environmental Chemistry	2			2	
8	SPK60310	Chemical Instrumentation	2	1		3	
9		Additional Chemistry Competency Course	2			2	
10		MK Additional Educational Competency 2	2			2	
		Number of credits	**19**	**3**		**22**	

Semester 6

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MWK60209	Indonesian	2			2	
2	SPK60205	Chemistry Micro Learning		2		2	
3	SPK60210	Learning Carbon and Macromolecular Chemistry	2			2	
4	SPK60213	Environmentally Friendly Experimental Design	2			2	
5	SPK60216	Chemistry Education Research Instruments		2		2	
6	SPK60217	Analysis of Chemistry Education Research Data	2			2	
7	SPK60218	Qualitative Research on Chemistry Education	2			2	
8	SPK60219	Chemistry Education Seminar		2		2	
9	SPK60305	Biochemistry	2	1		3	
10	SPK60229	Chemical Research		2		2	
		Number of credits	**12**	**8**		**21**	

Semester 7

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MLK60601	Educational Practice			6	6	
2	MLK60605	Community Service Program (KKN)			6	6	
3	SPK60220	Scientific Publication of Chemistry Education		2		2	
		Number of credits		**2**	**12**	**14**	

Semester 8

No	Code	Course Name	T	P	L	Amount	Prerequisite
1	MKK60801	Thesis			8	8	
		Number of credits			**8**	**8**	

H. Course Description

No	Code	Course Name	Course Description
Compulsory Curriculum Courses (MKWK)			
1	MWK60201	Islamic education	The Islamic Religious Education course is mandatory for all Muslim students. This course aims to strengthen students' faith and piety towards Allah SWT, as well as to develop noble morals (character), and to broaden their scientific and religious horizons. This will produce Muslim students with noble character, philosophical thinking, rational and dynamic attitudes, and broad perspectives, while paying attention to the demands of fostering harmony among fellow human beings, both within the same religious community and with those of other faiths. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
	MWK60202	Catholic Religious Education	Catholic Religious EducationIt is mandatory for every Catholic student to pass this course.aims to form students who are faithful, pious to God Almighty, have noble character, think philosophically, act rationally and dynamically, have broad views, and are able to cooperate between religious communities. This course examines: 1) The calling of a holy human life according to the scriptures; 2) Human relations with oneself, others and God; 3) Religion and faith lived in plurality; 4) Jesus Christ; 5) The Church and faith in society. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
	MWK60203	Protestant Christian Religious Education	Christian Religious EducationIt is mandatory for all Protestant Christian students to pass this course.aims to form students who believe in and are pious towards God Almighty, have noble character, think philosophically, act rationally and dynamically, have broad views, and are able to cooperate with other religious communities. This course examines: 1) The calling of a holy human life according to the scriptures; 2) Human relations with oneself, others and God; 3) Religion and faith lived in plurality; 4) Jesus Christ; 5) The Church and faith in society. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
	MWK60204	Hindu Religious Education	The Hindu Religious Education course aims to help students become believers and pious to God Almighty, have noble character, think philosophically, behave rationally and dynamically, have broad views, participate in interfaith cooperation in the development and utilization of science and technology and art for the benefit of humanity and the nation. Hindu religious education as part of the national education system is expected to contribute to eradicating moral decline and other negative effects. The course material includes the history of Hinduism, the teachings of Brahmavidya, the role of Vedic studies in building an

No	Code	Course Name	Course Description
			understanding of holy books and sources of law, the concept of Hindu humans and Hindu moral teachings. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
	MWK60205	Buddhist Religious Education	Buddhist Religious Education courseIt is mandatory for every Buddhist student to passaims to form students who have faith and are devoted to God Almighty, with good character noble, philosophical thinking, rational and dynamic attitude, broad-minded, able to cooperate between religious communities. This course examines: humans and religion; Buddhism; sources of Buddhism; basic framework of Buddhism's teachings Buddha; dharma;*please*; meditation; Buddhism and science; and case studies. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
	MWK60206	Confucian Religious Education	This course aims to instill Confucian values through the learning process, both in class and outside the classroom. Emphasis is placed on the urgency of Confucian religious education to shape young people who have a sense of nationalism, love for the homeland in the context of Confucian religious values and morals, Pancasila and the 1945 Constitution. The material begins with an understanding of the goals of Confucian religious education in the aim of enlightening the life of the nation, historical, sociological, and political sources of Confucian religious education; the purpose of life and after life of humans; the essence and urgency of integrating faith, belief and prostrations in the formation of virtuous humans; as well as the concepts of spiritual values and their implementation in the context of modernity and Indonesianness. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
2	MWK60207	Civic education	This course is mandatory to pass. This course aims to equip students with basic knowledge and skills regarding the relationship between citizens and the state, as well as national defense education so that they become citizens who can be relied upon by their nation and state. This course examines: (1) Rights and obligations of citizens (2) National defense education (3) Indonesian democracy (4) Human rights (5) Nusantara insight as Indonesian geopolitics (6) National resilience as Indonesian geostrategy (7) National politics and strategy as the implementation of Indonesian geostrategy. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
3	MWK60208	Pancasila	This course aims to develop Pancasila-minded citizens. It discusses the foundations and objectives of Pancasila Education, Pancasila in the context of the history of the Indonesian people's struggle, Pancasila as a philosophical system, Pancasila as a political ethic and national ideology, Pancasila in the context of the Indonesian state system, and Pancasila as a paradigm for life in society, the nation, and the state. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.

No	Code	Course Name	Course Description
4	MWK60209	Indonesian	This course aims to equip students with the competency to use Indonesian in writing scientific papers. Topics covered include Indonesian grammar, paragraph development, paragraph types, paragraph reasoning, types of scientific papers, scientific writing format, writing references, writing a bibliography, and how to create citations. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
Compulsory University Courses (MKWU)			
5	MWU60201	English for Specific Purposes	This course is expected to equip students with the skills to write and communicate orally scientifically in English, particularly in the context of chemistry and chemistry education. Students will learn about the nomenclature and terminology of chemistry and chemistry education, journal analysis, academic text reading skills and strategies, and English communication. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
6	MWU60202	Sports and Physical Fitness	This course aims to create physically healthy people.Learning activities consist of face-to-face lectures, using discussion methods and structured assignments. Assessment is based on several aspects, including attitude, activeness, structured assignments, midterm exams, and final exams, each with a different weighting.
7	MWU60203	Education and Sustainable Development	This course aims to prepare future generations for sustainable living. The material covered includes government policies related to education and the environment (Asta Cita), as well as sustainable development goals compiled by the United Nations, including 17 indicators according to the UN-SDGs. Learning activities consist of face-to-face lectures using discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
Faculty Courses (MKF)			
8	FMI60201	Insight into Mathematics and Natural Sciences Studies	The Science Insight and Study course is a faculty course with a weight of 2 credits. This course aims to provide students with an integrated insight into science in science. This course covers theories about the integration of various scientific disciplines for the benefit of the development of chemistry, including photosynthesis and the food chain, the philosophy of science, logic, principles of decision-making, scientific methods, scientific attitudes and character building, the relationship of mathematics and science to other natural sciences, biology and the integration of each system, and the role of science in the development of research and technology. Learning activities are designed as blended learning, combining face-to-face learning in class and online learning with the assistance of Besmart. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
9	FMI60202	Basic Statistics	The Basic Statistics course aims to equip students with the ability to collect, present, and process data. The course material includes (1) the definition and role of statistics; (2) methods of collecting and presenting data; (3) calculating and interpreting measures of central tendency, location, and data distribution; (4) the basics of probability theory; (5) distribution of random variables; (6) sampling theory; (7) parameter estimation; (8) hypothesis testing.

No	Code	Course Name	Course Description
			Learning activities are designed for face-to-face classroom sessions. Assessment is based on several aspects, including attitude, active participation, structured assignments, midterm exams, and final exams, each with a different weighting.
Basic Education Course (MKDK)			
10	MWP60201	Educational Science	This course aims to prepare students to become good educators. This course discusses the basic principles of education and the basic concepts of educational science and their application in educational practice, including: educational phenomena, historical perspectives on education, the nature of education and educational science, education as a system, and issues (problems) in education in the context of educational renewal (innovation). Learning activities are designed face to face in class. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
11	MWP60202	Educational Psychology	Educational psychology studies various aspects of the human psyche and behavior in the learning process. This course examines the basic concepts of educational psychology, including the importance of educational psychology, individual development, individual differences, sociocultural diversity, learners with learning difficulties, various approaches to learning, complex cognitive processes, motivation, classroom management, and learning evaluation. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
12	MWP60203	Educational Management	The Educational Management course is a university course and is mandatory for students of education programs with a weight of 2 credits. This course discusses the basic concepts, roles, and scope of educational management, followed by an in-depth study of management in the field of educational management, which includes: students, curriculum, educational staff, educational facilities, educational financing, administration of educational institutions and the relationship between educational institutions and the community, as well as educational leadership and educational supervision. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
13	MWP60204	Sociology and Anthropology of Education	This course discusses education as a socio-cultural process. This course provides foundational knowledge about socio-cultural approaches and influences, both from school and from outside school (family, peer group, community-nation, and mass media) in a multicultural (pluralistic) society and the education that is most appropriate to the Indonesian human (anthropos) in realizing Indonesia's national education goals now and in the future. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
14	MWP60205	Inclusive Education	The inclusive education course material studies the basic concepts of inclusive education, the philosophy and basic principles of inclusive education, inclusive education policies and regulations, the diversity of students with special needs (PDPD), PDPD identification, PDPD learning adaptation, inclusive education support systems, ethical issues and policy foundations surrounding inclusive education, learning systems and processes in the context of inclusive schools. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments.

No	Code	Course Name	Course Description
			Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
Learning Process Skills Course (MKKPP)			
15	SPK60201	Chemistry Curriculum and Learning	After taking this course, students are expected to be able to understand the basic concepts of curriculum, curriculum components, factors in developing curriculum, curriculum development models, SNP, the applicable national curriculum, chemistry learning curriculum in high school and its development, and be familiar with the international chemistry curriculum. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
16	SPK60202	Chemistry Learning Model	Through this course, students are expected to be able to understand the concepts and types of approaches, methods, techniques, models, components of learning models, approaches and models that are in accordance with the applicable curriculum and analyze the differences between various learning models and their selection for chemistry learning. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
17	SPK60203	Chemistry Learning Media and Resources	This course studies the definition of learning media, the role and function of learning media, types of learning media, planning and selection of learning media, learning media production techniques, learning media presentation techniques, and evaluation of learning media, which is specifically for chemistry learning, as well as studying the concept, types of learning resources and quality of chemistry learning resources. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
18	SPK60204	Chemistry Learning Assessment	Chemistry Learning Assessment is a compulsory course that studies all stages from planning, implementation, and reporting in chemistry learning assessment. Lecture materials include: Principles, objectives, and ethics of assessment, preparation of techniques and instruments for chemistry learning assessment (exams, non-exams, and alternative assessments), construction of good questions and instruments, conversion of scores to grades (PAP and PAN), analysis of test items (level of difficulty, discriminatory power, distribution of answers) and validity and reliability tests of assessment instruments. Various new approaches are discussed in this lecture, including the classification of competencies based on the dimensions of cognitive processes and knowledge dimensions, LOTs and HOTs, implementation of the principles of Assessment of Learning, Assessment for Learning, and Assessment as Learning, as well as new paradigms of assessment in the dynamics of curriculum change. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment techniques in this course include activities, case based, projects, mid-term and final exams.
19	SPK60205	Chemistry Micro Learning	The microlearning course is a peer-teaching course conducted in groups (7-10 students each) and supervised by one or two competent lecturers. In this course, students develop teaching skills for guided teaching

No	Code	Course Name	Course Description
			practice using specific learning models and reflect on their learning. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is carried out using non-test techniques through observation during learning practices.
Off-Campus Learning Courses (MKPLK)			
20	MLK60601	Educational Practice	Educational practicum is the practical activity of teaching chemistry in high schools or vocational schools. This course aims to train students' skills in designing, implementing, and evaluating learning, developing personality, and managing educational programs in schools. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is carried outwith non-test techniques through observation during learning practice.
21	MLK60605	Community Service Program (KKN)	This course is a field course that is expected to be able to teach students to apply knowledge and develop ethics in community life, provide solutions to problems in society appropriately by emphasizing the involvement of local wisdom and regional potential.
Scientific Development Course (MKPK)			
22	MKK60301	Research methodology	This course studies the principles of research methodology which include problems, objectives and benefits of educational research, types of educational research, research methods in quantitative approaches, development research, classroom action research, sampling techniques, and educational research variables. Activitylearning in the form of face-to-face lectures with discussion methods and giving structured assignments. Assessment is based on several aspects, namely attitude, activeness, structured assignments, mid-semester exams, and final semester exams with different weights for each aspect.
23	MKK60801	Thesis	This course equips students with the skills to analyze problems in chemistry education, design solutions, conduct research, compile a research report in the form of a final thesis, reflect on the research process, and present their findings to a panel of examiners. The entire process is carried out under the intensive guidance of a supervisor. Assessment is carried out by an oral exam in front of the examining panel.
Study Program Scientific Foundation Course (MKPKP)			
Foundations of Chemistry Education Course			
24	SPK60206	Learning Structure, Chemical Bonding, and Stoichiometry	This course reviews the main concepts of structure, bonding, and stoichiometry in high school, potential causes of misconceptions, student learning difficulties and other problems, and analyzes pedagogical elements as an alternative to teaching concepts in high school to overcome the problems found.
25	SPK60207	Chemical Kinetics and Thermodynamics Learning	This course reviews the main concepts in chemical kinetics and thermodynamics material in high school, potential causes of misconceptions, student learning difficulties and other problems, and analyzes pedagogical elements as an alternative to teaching concepts in high school to overcome the problems found.
26	SPK60208	Learning Solution Chemistry	This course reviews the main concepts in the material related to solution chemistry in high school, potential causes of misconceptions, student learning difficulties and other problems, and analyzes pedagogical elements as an alternative to teaching concepts in high school to overcome the problems found.
27	SPK60209	Redox and Electrochemistry Learning	This course reviews the main concepts in redox and electrochemistry materials in high school, potential causes of misconceptions, student learning difficulties and other problems, and analyzes pedagogical elements as an alternative to teaching concepts in high school to overcome the problems found.
28	SPK60210	Learning Carbon and Macromolecular Chemistry	This course reviews the main concepts in carbon and macromolecule chemistry material in high school, potential causes of misconceptions, student learning difficulties and other problems, and analyzes

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			pedagogical elements as an alternative to teaching concepts in high school to overcome the problems found.
29	SPK60211	Chemistry Learning in Vocational Schools	The SMK Chemistry course is a compulsory course in the UNY Undergraduate Chemistry Education Study Program which aims to prepare and equip students with competencies to become prospective chemistry teachers in SMK. The SMK Chemistry course: examines the dynamics of curriculum changes and the Spectrum of Expertise in SMK, identifies and describes the characteristics of chemistry learning in SMK, analyzes and creates a chemistry content matrix in the SMK curriculum in various areas of expertise, discusses selected topics for strengthening SMK Chemistry, and designs the Operational Curriculum of Educational Units in SMK as well as creates papers/articles on innovations in Chemistry learning in SMK. This course is implemented with the Problem Based Learning and Project Based Learning models. Assessment techniques in this course include activities, case based, projects, midterm exams and final exams.
30	SPK60212	Chemistry Learning for Continuing Education	Chemistry Learning for Sustainable Development is a course that discusses the principles of Education for Sustainable Development and SDGs and their implementation in chemistry learning. Lecture materials include: integrating the SDGs framework, differentiating implementation strategies, and analyzing obstacles and analyzing indigenous knowledge when applying ESD in chemistry learning, the principles of green chemistry, as well as the concept of transformative education and its aspects, examining the implications of developing or implementing ESD-based chemistry learning in high schools/vocational schools. Furthermore, students plan SDGs-oriented chemistry learning according to the characteristics of the material (content knowledge) and the characteristics of students, approaches, sources and learning media (pedagogical knowledge). Assessment techniques in this course include activities, case-based, projects, mid-term and final exams.
31	SPK60213	Environmentally Friendly Chemistry Experiment Design	The Green Chemistry Experiment Design course equips students with the knowledge and skills to design, implement, and analyze chemical experiments based on the principles of green chemistry. The main focus of this course is the development of experimental methods that are safe, efficient, and have minimal negative impacts on the environment. The material covers the principles of green chemistry, experimental design approaches (such as Completely Randomized Design, factorial, and surface response), the selection of environmentally friendly reagents and solvents, and the analysis of experimental data. Students will also be guided to develop a scientific attitude, laboratory ethics, and environmental awareness in chemistry practice. This course is highly relevant to support the development of sustainable chemical research and innovation.
32	SPK60214	Chemistry Learning Program Development	This course is designed to provide students with the skills and abilities to develop active TPACK-based chemistry learning programs. Innovative, creative, engaging, and authentic. The study materials in this course include: compiling annual and semester programs, analyzing core competencies (KI-KD), GPA, and materials, designing lesson plans and their tools with educational, contextual, and student-centered learning strategies.
33	SPK60215	Chemistry Learning Research Study	This course examines various new trends in chemistry learning that are becoming issues in education in Indonesia and globally through the analysis of research articles in national and international journals. Students will deeply examine specific topics according to their interests, which will become the topic of their final project research.
34	SPK60216	Chemistry Education Research Instruments	This Chemistry Education Research Instruments course equips students with the practice of developing various educational research instruments in the form of tests, questionnaires, measurement scales, rubrics.,coding analysis sheet and validation sheets, which will be used in chemical education research that meets the requirements of good instruments and determines the validity and reliability of the instrument construct with the help of software.

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35	SPK60217	Analysis of Chemical Education Research Data	This course studies data analysis design, univariate descriptive and inferential statistical data analysis, including parametric and nonparametric difference tests and correlation tests, as well as data analysis practices using software to support chemistry education research.
36	SPK60218	Qualitative Research on Chemistry Education	This course discusses various qualitative research methods, namely, exploratory surveys, case studies, phenomenology, and documentary, as well as their application to chemistry education research, developing instruments, collecting data, content analysis, interator reliability, interpreting results and drawing conclusions.
37	SPK60219	Chemistry Education Seminar	The seminar course is a course that focuses on the oral presentation of a research proposal/thesis. This course aims to prepare and equip students with the skills to develop a research proposal for their final project and present it at a seminar along with a draft of the research instrument. The course material covers the concept of a thesis and scientific work, the steps for developing a research proposal using various educational research methods, and a discussion of the POB TAS.
38	SPK60220	Scientific Publication of Chemistry Education	This course studies various forms of scientific writing, how to write scientific articles based on research, plagiarism and intellectual property rights, and how to publish articles. scientific and put it into practice.
Foundations of Chemistry Course			
39	SPK60401	Basic Chemistry	This course discusses the fundamental concepts of chemistry, including the scientific method, components of matter, stoichiometry and chemical reactions, gaseous states, atomic structure, the periodic table of elements, chemical bonding, and organic compounds.
40	SPK60221	Mathematics for Chemistry	The Mathematics for Chemistry course covers mathematical concepts and their applications in chemistry. These concepts include: coordinate systems, functions of one or more variables, differential integration, differential equations, matrices and determinants, operators and vectors, and data processing.
41	SPK60222	Fundamentals of Computational Chemistry	This course discusses computational chemistry methods, the advantages and disadvantages of each method, and the application of modeling simple molecules. This course covers the basic concepts of computational chemistry, including computational chemistry methods and their applications.
42	SPK60301	Chemical Equilibrium	This course covers gas laws, the first law of thermodynamics, thermochemistry, the second and third laws of thermodynamics, the Gibbs free energy function, chemical equilibrium, colligative properties, electrochemical equilibrium (voltaic cells), and colloids. The course covers theory and laboratory practice.
43	SPK60302	Molecular Dynamics	This course examines molecular dynamics, covering the kinetic theory of gases, molecular motion (including conductivity and diffusion), chemical reaction rates (including empirical chemical kinetics and an explanation of rate laws), and the kinetics of complex reactions. The course includes both theory and laboratory practice.
44	SPK60303	Basic Organic Chemistry	This lecture covers theory and practice covering basic organic reactions, structure, nomenclature, properties, reactions, and reaction mechanisms: alkanes, alkenes and alkynes; halo alkane compounds; benzene and its derivatives; alkanol compounds, alkoxy alkanes, diols and thiols; alkanal and alkanone compounds; alkanoic acids; alkanoic acid derivatives and amine nitrogen compounds.
45	SPK60304	Structure of Polyfunctional Organic Compounds	This course examines molecular dynamics, covering the theory of gas kinetics, moving molecules (including gases and solutions), chemical reaction rates (including empirical chemical kinetics and an explanation of rate laws), and macromolecules. The course includes both theory and laboratory practice.
46	SPK60223	Determination of the Structure of Organic Compounds	The course on Determination of Organic Compound Structures covers the basic concepts of spectroscopy, the basic principles of UV, IR, NMR, and MS spectroscopy, as well as elucidation of the structure of organic compounds based on these spectroscopic data.
47	SPK60305	Biochemistry	This course is specifically designed for Chemistry Education students to understand basic biochemical concepts relevant to the secondary

No	Code	Course Name	Course Description
			education curriculum. The primary focus is on the structure, function, and transformation of biomolecules (carbohydrates, lipids, proteins, and nucleic acids), as well as the basic metabolic processes that occur within living cells. Students will also be introduced to the role of enzymes and the bioenergetics concepts underlying biochemical reactions. Simple biochemistry labs are also included to support basic laboratory understanding and skills.
48	SPK60306	Structure of Inorganic Compounds	This course studies the Structure of Inorganic Compounds which includes the basic concepts of atomic structure, matter and waves; types of bonds in chemistry (including ionic, covalent and valence bonds); properties of solids and how to determine lattice energy with several approaches (namely: Born-Lande, Kapustinski and Born-Haber cycles); crystals and determination of crystal coordinates / Miller index and applications of solids both pure and in the form of mixtures; molecular orbital theory and the geometry of complex compound molecules.
49	SPK60307	Basics of Inorganic Reactions	After completing this course, students will be able to explain the basic principles of inorganic reactions, identify acid-base reactions and redox reactions, show the relationship between acid-base reactions and redox reactions, classify acids and bases (Arrhenius, Bronsted-Lowry, Lewis, Ussanovic), compare acid-base reactions and redox reactions, recognize the properties of non-aqueous solvents, inorganic reactions in non-aqueous media, classify non-aqueous solvents, identify the properties of non-aqueous solvents, choose non-aqueous media for inorganic reactions, and exemplify the role of non-aqueous solvents in the dissolution process.
50	SPK60224	Coordination and Organometallic Chemistry	Coordination and Organometallic Chemistry discusses the Chemistry of Transition Elements, Complex Compounds, the Concept of Effective Atomic Number, and Valence Bond (Hybridization) Theory, Crystal Field Theory (Ligand Field Theory): Molecular Orbital Theory of Complex Compounds, Chemistry of the Inner Transition Elements (4f and 5f), and Applications of Complex Compounds.
51	SPK60308	Fundamentals of Analytical Chemistry	Fundamentals of Analytical Chemistry covers qualitative and quantitative analysis. Qualitative analysis is the identification of sample components using specific reagents. Quantitative analysis is the determination of quantities (grams, percentages) using volumetric techniques. Lectures emphasize the ability to master course material logically and scientifically and the ability to use scientific methods to solve problems faced by students.
52	SPK60309	Chemical Separation Methods	This lecture examines various principles of analytical separation, several influencing factors, electrochemical separation and analysis methods and membrane separation.
53	SPK60310	Chemical Instrumentation	This lecture covers theory and practice in the laboratory covering the scope of instrumental chemistry, colorimetry, UV-VIS spectrophotometry, FTIR, Mass, NMR, and SSA.
54	SPK60225	Environmental Chemistry	This course examines the sources, reactions, transport, effects and influences of chemical species in the air, water and soil environment, and living creatures and the influence of human activities on these processes.
55	SPK60226	Applied Chemical Technology	The Applied Chemical Technology course examines the application of chemical principles to industrial processes and technologies related to the production of chemicals, energy, materials, and consumer products. Students will learn the basic concepts of chemical process engineering, separation technology, energy conversion, waste treatment, and the use of renewable raw materials. Furthermore, this course examines modern technological developments such as nanotechnology, biotechnology, and sustainable chemical processing. Students are expected to analyze and propose technological solutions to chemical problems in the industrial world, taking into account efficiency, safety, and environmental impact.
56	SPK60227	School Chemistry Laboratory Management	In this course, the material studied is (1) the definition, purpose and scope of laboratory management, (2) the definition and function of laboratories, (3) laboratory design and layout, (4) equipment

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			management, (5) materials management, (6) equipment selection criteria, (7) work safety in the laboratory, (8) assessment of learning activities in the laboratory, (9) laboratory waste management, (10) hazardous experimental techniques, and (11) MSDS.
57	SPK60228	Chemistry-Based Entrepreneurship	This course equips students to prepare business plans and practice small businesses based on chemistry or chemistry education and market them. The course is carried out with projects.
58	SPK60229	Chemical Research	This course studies the basics of chemical research methods, practices and the preparation of simple chemical research reports which can later be applied to support the development of scientific work activities in schools.
Additional Competency Courses (MKTK)			
Additional Courses for Chemistry Education Competencies			
59	SPK60230	Trends in Chemistry Learning Strategies	Trends in Chemistry Learning Strategies is a competency strengthening course that examines the philosophy, concepts, and integration of learning strategies that are new trends in chemistry learning in high schools and vocational schools, analyzing concepts, implementations, weaknesses and strengths of various trends in chemistry learning strategies such as STEM learning, transformative education, differentiated learning, social emotional learning; developing TPACK-based chemistry learning tools in accordance with existing trends logically and systematically, then collaborating to communicate the results of problem solving in chemistry learning by implementing new learning strategies. Assessment techniques in this course include activities, case-based, projects, mid-term exams and final exams.
60	SPK60231	Culture-Based Chemistry Learning	The Culture-Based Chemistry Learning course equips students with the knowledge, understanding, and skills to design and implement chemistry learning that integrates local cultural values as the learning context. Through this approach, students are invited to explore the relationship between chemical concepts and cultural practices, local wisdom, and local community traditions to create contextual, relevant, and meaningful learning for students. Lecture materials include the concept of ethnoscience, analysis of cultural content in chemistry learning, culture-based learning strategies, and the development of teaching tools that prioritize local cultural uniqueness. This course is implemented with a participatory and reflective approach through discussions, case studies, and the development of learning projects. Assessment techniques in this course include class activities, case-based assessments, project-based assessments, mid-term exams, and final exams.
61	SPK60232	*Socio-scientific Issues*in Chemistry Learning	The Socio-scientific Issues in Chemistry Learning course discusses the integration of controversial scientific issues, particularly those focused on chemistry, into the learning process. and equips students with the ability to design SSI-based chemistry learning that encourages students to think critically, make ethical decisions, and build awareness of the social and environmental impacts of chemistry and increase the relevance of chemistry learning. The lecture process is carried out through discussions, issue analysis, development of teaching materials, and projects based on socio-scientific issues. Assessment techniques in this course include class activities, case-based assessments, project-based assessments, mid-term exams, and final exams.
62	SPK60233	Thinking Strategies in Chemistry Learning	Thinking Strategies in Chemistry Learning is an additional (reinforcement) course that examines thinking patterns and the development of thinking strategies in learning chemistry materials as well as learning strategies to improve students' thinking abilities. Lecture materials include Development of human thinking patterns, Cognitive strategies and LOTS and HOTS thinking skills, Critical Thinking, Creative Thinking, Analytical Thinking, Multiple Representations, Elaborative Encoding, Visuospatial thinking, Systems Thinking in Chemistry Education, Problem Solving and Decision Making, Logical Thinking: Scientific Argumentation Skills in Chemistry, Thinking in Systems and Mental Models, Computational thinking.

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			Assessment techniques in this course include activities, case-based, projects, mid-term and final exams.
63	SPK60234	Chemical Modeling for Learning	The Chemical Modeling for Learning course is designed to equip students with the understanding and skills to develop and use models and modeling as conceptual tools in chemistry learning. Students will learn various types of models (macroscopic, microscopic, symbolic, and mathematical) and the thinking processes of models and modeling to help students understand abstract chemical concepts. In addition, this course also discusses chemical representation, the relationship between models, and effective learning strategies based on models and modeling. Students will be trained to design learning activities that involve the creation, interpretation, and evaluation of chemical models creatively and scientifically.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
64	SPK60235	Development of Electronic Chemistry Learning Resources	This course equips students with the ability to develop teaching materials in the form of modules, LKPD, virtual laboratories or electronic textbooks by integrating chemical modeling approaches and certain learning approaches/models.
65	SPK60236	Educational Games in Chemistry Learning	The Educational Games in Chemistry Learning course provides students with the skills to utilize and develop both traditional and digital games as educational media in chemistry learning in high school and as an introductory chemistry medium for middle and elementary school students.
66	SPK60237	Social Media in Chemistry Learning	This course emphasizes the development and utilization of social media to introduce and teach chemistry to the public related to topics in everyday life or popular h with a social approach such as vodcast.
67	SPK60238	Diagnostic Tests in Chemistry Learning	This course discusses the types and forms of diagnostic tests such as identifying misconceptions, learning difficulties, chemistry learning anxiety and developing good tests.
68	SPK60239	Multimodality in Chemistry Learning Assessment	The Multimodal Assessment of Chemistry Learning course discusses the concepts, principles, and practices of assessment involving various modes or forms of representation to measure students' understanding and skills in chemistry learning. Students will learn how to use multimodal approaches such as text, visuals, diagrams, symbols, digital simulations, motion, and verbal communication to design assessment instruments that are authentic, inclusive, and able to represent the diversity of students' ways of thinking. This course also emphasizes the importance of formative and summative assessments that not only measure learning outcomes, but also students' thinking processes and representational abilities in the context of chemistry. Students will be trained to develop rubrics and multimodal-based assessment instruments, and analyze the results to improve learning.
69	SPK60240	Chemistry Project Based Assessment	Project-Based Assessment in Chemistry Learning is an additional (reinforcement) course that studies the new paradigm of project-based learning (concepts, principles, syntax models) and integrates it into innovative chemistry learning, as well as developing measurement instruments for the process, product, and creativity of the projects being implemented. Optimizing the use of reference information and the latest research on project-based learning to complete project assignments independently, with quality, and measurable. Assessment techniques in this course include activities, case-based, projects, mid-term exams, and final exams.
70	SPK60241	History and Perspectives of Chemistry	This course on the History and Perspectives of Chemistry studies the development (history) of chemistry from prehistoric times to the early 20th century through a philosophical analysis of this historical development, emphasizing how chemists of the past thought and worked while simultaneously developing, evaluating, and using new theories and practical methods, as well as their applications in the chemistry learning process in secondary schools.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.

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71	SPK60242	Chemistry Teacher Professional Development	This course explores the concepts of the teaching profession and teacher professionalism, the development of PCK/TPACK, and the Continuing Professional Development (CPD) program for chemistry teachers, through discussions, case analysis, and projects. To measure students' mastery of the course material, two tests are conducted: mid-term and final exams, as well as a portfolio assessment.
72	SPK60243	Review of the international chemistry curriculum	The International Chemistry Curriculum Review course equips students with critical and comparative insights into various chemistry curricula from countries around the world. Students will examine the characteristics, structure, objectives, learning approaches, and learning outcomes of international chemistry curricula, such as the IB (International Baccalaureate), Cambridge, Next Generation Science Standards (NGSS), and national curricula of other developed countries. The course emphasizes comparative analysis between international curricula and the Indonesian chemistry curriculum in terms of content, learning strategies, STEM integration, assessment, and the development of 21st-century competencies. Through this course, students are expected to be able to draw inspiration for improvements and innovations in chemistry learning that are more contextual and globally competitive.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
73	SPK60244	Management of Scientific Extracurricular Activities in Schools	This course examines the management of youth scientific work activities in schools, including planning, management, and evaluation, as well as student and activity management. Students are given an understanding of extracurricular activities.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
Additional Chemistry Competency Course			
74	SPK60245	Nuclear Chemistry and Radiochemistry	This course studies the ins and outs of radiochemistry and nuclear chemistry which includes the phenomena of radioactivity, the structure of the atomic nucleus, radioactive decay, nuclear reactions, the properties of nuclear radiation and its interactions with matter and living things, nuclear reactors, the production of radioisotopes and their use in various fields of life. Learning activities include lectures with various approaches and methods that involve many students, such as lectures, interactive discussions, critiquing video content, assignments, writing papers, class presentations.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
75	SPK60246	Colloidal Chemistry and Surfactants	The Colloid and Surfactant Chemistry course discusses the basic principles and applications of colloid and surfactant systems in various scientific and industrial contexts. Students will learn the characteristics of colloid systems, the stability and destabilization of colloids, the types of surfactants, their mechanisms of action, and the interactions between colloids and surfactants in solution. In addition, this course also reviews the application of colloids and surfactants in everyday products, such as detergents, emulsions, cosmetics, food, as well as in chemical processes and environmental technology. Understanding of these concepts is supported by practical work and case studies to develop analytical and problem-solving skills.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
76	SPK60247	Membrane Technology	This course provides an explanation of the basics of membrane technology, the principles of membrane separation, preparation of ceramic and polymer membranes, characterization of membrane materials, membrane processes and systems, membrane applications for food processing, drinking water supply, waste purification and polymer electrolytes.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
77	SPK60248	Nanochemical Technology	The Nanochemical Technology course discusses the basic concepts and applications of nanochemical technology in various fields of science and industry. Students will learn the principles of nanochemistry, including the creation and characterization of nanomaterials, and how the unique properties of materials at the nanoscale can be utilized in technology, pharmaceuticals, biotechnology, energy, and the environment. This

No	Code	Course Name	Course Description
			course also covers topics on nanomaterial synthesis techniques, the physical and chemical properties of nanomaterials, and the challenges and potential applications of nanotechnology in the development of materials science-based products and solutions. Students will be involved in case studies and projects based on nanochemical applications to enhance their understanding and practical skills.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
78	SPK60249	Polymer Chemistry	The material chemistry course: catalyst chemistry is an elective course for chemistry study program students that has a contribution in strengthening students' cognitive and psychomotor competencies in fulfilling the learning outcomes of study programs and courses delivered through polymerization process materials (addition and condensation reactions) step and chain polymerization processes, polymer compound nomenclature, industrial polymers including elastomers, plastics and fibers, molecular weight measurement and molecular weight distribution, chemical structure and polymer morphology.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
79	SPK60250	Industrial Chemistry	SubjectThis is designed to provide an understanding of the types of raw materials, sources of raw materials, and processes.chemistrywhich is developed in variouschemical industryand the selection of conditions that cause the reaction to occurchemistry(product) inindustryefficiently.
80	SPK60251	Pharmaceutical Chemistry	This course discusses the basics of pharmaceutical chemistry, including chemical bonds and intermolecular forces, orbitals and their role in covalent bonds, functional groups of drug compounds, compound nomenclature, isomers and stereochemistry, nucleophilic substitution reactions and elimination reactions in alkyl halide compounds, reactions in alcohol compounds, basic calculations and measurements in the field of pharmaceutical chemistry and gravimetric analysis methods.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
81	SPK60252	Natural Material Chemistry	This lecture discusses the structure, biosynthesis pathways, reactions, structure determination, and uses of terpenoids, steroids, phenylpropanoids, polyketides, flavonoids, and alkaloids. The lecture is delivered using an expository and conceptual approach, incorporating lecture, discussion, and problem-solving methods using LCD and OHP media.Assessment techniques in this course include activities, case based, projects, mid-term exams and final exams.
82	SPK60253	Food Material Analysis	The Food Analysis course equips students with the knowledge and skills to conduct chemical and physical analyses of food. Students will learn analytical techniques used to identify the chemical components of food, including nutrients, additives, hazardous substances, and contaminants. Furthermore, this course examines food safety standards and regulations related to food products consumed by the public. Students are expected to master appropriate analytical methods to ensure food quality and safety.
83	SPK60254	Chemical Waste Management	The Waste Management Engineering course aims to support graduate learning outcomes (CPL5) to be able to contribute to solving problems within the scope of their work in the form of waste management capabilities based on knowledge (understanding) of sources, characteristics, and principles of waste management, as well as waste management systems for waste-producing sources with awareness of minimizing waste and the impact of waste management on public health aspects.