

CURRICULUM

BACHELOR OF CHEMISTRY EDUCATION



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DEPARTEMENT CHEMISTRY EDUCATION
FACULTY OF MATHEMATICS AND
NATURAL SCIENCE
YOGYAKARTA STATE UNIVERSITY

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YOGYAKARTA STATE UNIVERSITY
YEAR OF 2022

1. VISION AND MISSION

A. Vision

The vision of the Chemical Education Study Program is as follows: “By 2025, the Chemical Education Study Program will be established as a quality-based and leading program in Southeast Asia in the development of learning and research, aimed at producing graduates in Chemical Education who possess pedagogical, professional, personal, and social competencies, are globally competitive, and embody the characteristics of piety, independence, and intellectuality.”

B. Mission

In order to achieve its future vision, the Chemistry Education Study Program carries out the following missions:

1. Conducting education to produce graduates in Chemistry Education who process pedagogical, professional, personal, and social competencies, and are capable of contributing in the global era.
2. Advancing chemistry education through research and innovation based on character education aligned with local wisdom and the life context of learners, and disseminating research outcomes both nationally and internationally.
3. Engaging in community service by socializing the results of research and innovations in the field of chemistry education to stakeholders.
4. Establishing mutually beneficial collaborations with domestic and international partners to support the progress of chemistry and chemistry education.
5. Fostering the academic community to create a campus society that is devout, independent, intellectual, and possesses a deep love for the nation, state, and homeland.

2. PROFILE OF GRADUATE

The desired profile of chemistry education graduates is as follows.

Main Profile

- a. **Chemistry Educator.** In this field, alumni of the Chemistry Education Study Program have been equipped to be able to become educators both in formal institutions of primary and secondary education, higher education, as well as informal and non-formal institutions, including as chemistry curriculum developers and education management at the school level.
- b. **Chemistry Education Researcher.** In this field, alumni of the Chemistry Education Study Program FMIPA UNY have been equipped to be able to become researchers in the field of

chemical education with the distinctiveness of chemical education that is different from educational and or chemical research by applying various educational research methods in supporting educational programs for sustainable development and increasing the relevance of chemical education to society.

Additional Profile

- a. **Entrepreneur.** In this field, alumni of the Chemical Education Study Program are equipped with the ability to develop themselves so that they can take careers not only as educators or researchers in the field of chemical education but entrepreneurship, especially in the field of chemical education or the chemical field.
- b. **Education Manager.** In this field, alumni of the Chemistry Education Study Program are equipped with educational management concepts and skills to design learning programs in schools and educational activities in the community, laboratory management, and scientific extracurricular management in schools.
- c. **Chemistry Research Assistant.** In this field, alumni of the 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 or similar researchers.

3. LEARNING OUTCOMES (LO)

The learning outcomes of graduates of the undergraduate chemistry education study program are derived from the established profile and refer to the LO domain according to KKNL. LO are formulated in a concise and brief manner in accordance with the provisions of ASIIN and AUN-QA international accreditation and certification agencies.

Domain	Learning Program Outcomes
Attitude	Demonstrating religious zeal, moral integrity, ethical principles, and Indonesian character in communal, societal, and national life.
	Demonstrating independence and accountability in both individual and collaborative work in daily life and within the community.
Knowledge	Applying the concepts, principles, laws, calculations, and theories of chemistry, education, and chemical education, which are continually updated as part of lifelong learning, to solve problems in careers, daily life, and societal life, based on religious values and the philosophy of the state.
	Integrating concepts of chemistry, laboratory management and safety, pedagogical knowledge of chemistry, curriculum, strategies, learning resources, media, evaluation, classroom management, and ICT that support religious values and philosophical principles in chemistry learning activities.
	Understanding the methodology of chemistry education research and the characteristics of its research procedures in supporting educational programs for sustainable development and enhancing the relevance of chemistry education to society, as well as academic integrity in research and scholarly work.

	Understanding the concepts of educational program management and entrepreneurship in general, as well as within the fields of chemistry and chemical education.
General Skills	Able to adapt critical and creative thinking skills, prevent plagiarism, and argue scientifically in addressing issues within career, daily life, and societal contexts.
	Applying collaborative skills to build professional networks, self-development, and to resolve issues in career, daily life, and community living.
Specialized Skills	Planning, managing, and evaluating chemistry education in schools in accordance with the characteristics of the subject matter (content knowledge) and the characteristics of learners, teaching approaches, learning resources, instructional media (pedagogical knowledge), as well as relevant information and communication technology (technological knowledge) in an innovative and adaptive manner.
	Planning, managing, and evaluating laboratory activities by adhering to the principles of Occupational Health and Safety (OHS) and environmental issues in an innovative and adaptive manner.
	Identifying issues and determining alternative solutions based on theory and research findings, designing, implementing them in chemistry and chemistry education research, and publishing them in accordance with academic standards and integrity, supported by the application of digital competencies.
	Capable of communicating scientifically, both orally and in writing, to convey ideas or concepts in scientific forums using Indonesian and English, in support of sustainable development and enhancing the relevance of chemistry education with society.

4. OBJECTIVE AND LEARNING OUTCOME

The objectives of the Bachelor Chemistry Education Study Program FMIPA UNY are as follows.

1. PO-1: Graduates demonstrate piety, noble character, and pedagogical, professional, social, and scientific competencies in chemistry education; innovating and contributing globally.
2. PO-2: Graduates demonstrate the ability to produce research that is superior, creative, innovative, and beneficial to the world of education and society.
3. PO-3: Graduates disseminate knowledge and research for the benefit of the community and industry.
4. PO-4: Graduates demonstrate the ability to generate mutually beneficial cooperation at the national, regional and international levels
5. PO-5 : Graduates demonstrate devotion, independence, and intellectual character within the campus community and having a love for the nation, state, and homeland.

Domain	Program Learning Outcomes (ASIIN)	
Attitude	PLO1	Apply a religious, moral, ethical and spirit of Indonesian character in group life, society and the state.
	PLO2	Apply independence and responsibility in working individually and in groups in daily life and society.
Knowledge	PLO3	Apply the concepts of chemistry, education, and chemistry education to solve problems in careers, daily life and social life.
	PLO4	Integrate chemistry concepts, laboratory management, chemistry pedagogical knowledge, and ICT to support effective learning.
	PLO5	Apply the research methodology of chemistry education in supporting educational programs for sustainable development with academic integrity.
	PLO6	Apply the concept of educational program management and entrepreneurship in general as well as in the field of chemistry and chemical education.
General Skills	PLO7	Apply critical and creative thinking skills, prevent plagiarism, and argue scientifically in dealing with problems in careers, daily life and social life.
	PLO8	Apply collaborative skills to build networks, self-development, and solve problems in career, daily life and community life.
Specific skills	PLO9	Analyze chemistry learning in schools in accordance with the TPACK framework.
	PLO10	Apply OHS (Occupational Safety and Security) principles and environmental issues in laboratory activities in an innovative and adaptive manner.
	PLO11	Apply solutions from research to chemistry education, and publish them with integrity supported by digital competencies.
	PLO12	Apply scientific communication in Indonesian and English to convey ideas in forums and support sustainable development in chemistry education.

5. COURSE STRUCTURE

Program Course Description

No	Code	Course Name	Course Description
University Courses			
1	MKU6201	Islam Religious Education*	The course of Islamic Religious Education is mandatory for all Muslim students across all study programs at the university. This course is designed with the purpose of strengthening students' faith and piety towards Allah SWT, as well as cultivating noble character (akhlak) and expanding their intellectual and religious life perspectives. The aim is to shape Muslim students who possess high moral integrity, philosophical thinking, rational and dynamic attitudes, and broad outlooks, while also emphasizing the importance of fostering harmony among fellow human beings, both within the same religious community and with those of other faiths.
	MKU6202	Catholic Religious Education*	Catholic Religious Education aims to assist in the development of students who are faithful and devout to the One Almighty God, possess noble character, think philosophically, act rationally and dynamically, have a broad perspective, and participate in interfaith cooperation for the advancement and utilization of science, technology, and arts for the benefit of humanity and the nation. This course examines: 1) The sacred calling of human life according to the Scriptures; 2) The relationship of humans with themselves, others, and God; 3) Religion and Faith lived in plurality; 4) Jesus Christ; 5) The Church and Faith in society.
	MKU6203	Christian Religious Education*	The Christian Religious Education course aims to assist in the development of students who are faithful and devout to the One Almighty God, possess noble character, think philosophically, act rationally and dynamically, have a broad perspective, and participate in interfaith collaboration in the context of the development and utilization of science, technology, and the arts for the benefit of humanity and the nation. This course examines: 1) Humanity; 2) Christianity; 3) The Church; 4) Christian Faith, Science, and Technology (Faith, Love, and Hope); 5) Humanity and Development; 6) Ethical Issues in Social Life;

			7) Selected Topics (thematic selected issues).
	MKU6204	Hindu Religious Education*	The course in Hindu Religious Education aims to foster students who are faithful and devout to the One Almighty God, possess noble character, engage in philosophical thinking, exhibit rational and dynamic attitudes, maintain broad perspectives, and actively participate in interfaith cooperation for the development and utilization of science, technology, and the arts for the benefit of humanity and the nation. As an integral part of the national education system, Hindu Religious Education is expected to contribute to addressing moral decadence and other negative effects. The course material encompasses the historical role of Hinduism, the teachings of Brahavidya, the role of Vedic studies in developing an understanding of sacred scriptures and legal sources, the Hindu concept of humanity, and Hindu ethical teachings.
	MKU6205	Buddhist Religious Education*	The Buddhist Religious Education course aims to assist in the development of students who are devout and pious toward the Supreme Deity, possess noble character, think philosophically, act rationally and dynamically, have a broad perspective, and actively participate in interfaith cooperation for the advancement and utilization of science, technology, and the arts for the benefit of humanity and the nation. This course examines: human beings and religion; Buddhism; the sources of Buddhism; the fundamental framework of Buddhist teachings; Dharma; morality (Sila); meditation; Buddhism and science; and case studies.
	MKU6206	Confucian Religious Education*	This course is designed to instill Confucian values through the learning process, both inside and outside the classroom. It emphasizes the urgency of Confucian religious education in shaping youth who possess a sense of nationalism and love for their homeland, within the context of Confucian religious values and morals, Pancasila, and the norms of the 1945 Constitution. The course material includes an introduction to the legal foundation of the General Education Course (MKU) on Confucian religion, its vision, mission, and objectives. The content begins with an understanding of the objectives of

			Confucian religious education in the context of enlightening the nation's intellectual life, the historical, sociological, and political sources of Confucian religious education; the purpose of human life and the afterlife; the essence and urgency of integrating faith, belief, and devotion in shaping virtuous individuals; as well as the concepts of spiritual values and their implementation in the context of modernity and Indonesian identity.
2	MKU6207	Education Citizenship (Civic)	The Civic Education course is compulsory to pass for all undergraduate and D3 program students, weighing 2 credits. This course equips students with knowledge and basic skills regarding the relationship between citizens and the state, as well as preliminary education to defend the country in order to become a reliable citizen by the nation and country. This course examines: (1) Rights and obligations of citizens (2) Preliminary education for defending the country (3) Indonesian Democracy (4) Human Rights (5) Archipelago insight as Indonesian Geopolitics (6) National Resilience as Indonesian Geostrategy (7) National politics and strategy as the implementation of Indonesian Geostrategy.
3	MKU6208	Pancasila	This course discusses the foundations and objectives of Pancasila Education, Pancasila within the context of the historical struggle of the Indonesian nation, Pancasila as a philosophical system, Pancasila as political ethics and national ideology, Pancasila within the framework of the constitutional system of the Republic of Indonesia, and Pancasila as a paradigm for life in society, nation, and state.
4	MKU6209	Indonesian Language	This course aims to equip students with the competence to use the Indonesian language in academic writing. The topics covered include the historical development of the Indonesian language, its status and functions, Indonesian language writing conventions, paragraph development, types of paragraphs, reasoning within paragraphs, types of academic works, academic writing formats, reference writing, and bibliography compilation. Learning activities consist of face-to-face lectures,

			discussions, and structured assignments. Evaluation is conducted through written tests and structured assignments.
5	MKU6211	English Language	This course is designed for UNY (State University of Yogyakarta) students to develop their academic English proficiency, which can be utilized in the study of Chemistry and Chemistry Education. Students will learn about university-level study skills and strategies for reading academic texts in English. They will engage with academic texts by applying the study strategies they acquire. Through this course, it is expected that students will be equipped to write and communicate scientifically in English, particularly in the context of Chemistry and Chemistry Education.
6	MKU6212	Digital Transformation	Digital Transformation course, weighted 2 credits, discusses the basic material of digital transformation which includes: understanding digital transformation, transformation and digitization steps. The next material is the Four Pillars of Digital Transformation, Information capabilities for Competitive Advantage, Social Networks and Enterprise 2.0, Big Data Analysis, online business model. Furthermore, students are required to be able to analyze business models consisting of Re-engineering of business models, Digital Business Models, and Re-engineering of business processes. The end of this course will also discuss the concept of the Internet of Things. This course is taught through lectures, discussions, demonstrations, case studies, and assignments. Assessment is done through assignments, presentations, and exams. The objective of this course is for students to understand the important role of digitalization in modern life.
7	MKU6213	Creativity, Innovation and Entrepreneurship	This course aims to equip students with the following: fostering an entrepreneurial spirit and character, understanding the concepts of entrepreneurship, and developing entrepreneurial skills. The scope of the course material includes: cultivating an entrepreneurial spirit and character, achievement motivation, creative thinking, the essence of entrepreneurship, business ethics and

			social responsibility, generating new ideas, production management, finance, marketing and human resources, business opportunities, and business planning.
8	MKU6216	Social Literacy and Humanity	This course examines the existence of humans as cultural beings, civilized beings, individual beings, and social beings. It discusses humans in their diversity, equality, and dignity; humans in morality and law; humans with science and technology; and humans with their environment. The objective of the course is to enable students to develop into educated individuals who are critical, sensitive, and wise in understanding human diversity, equality, and dignity, grounded in aesthetic, ethical, and moral values in societal life.
Faculty Courses			
9	FMI6201	MIPA Insights & Studies	The course MIPA Insights & Studies is a faculty-level course with a weight of 2 credit hours. This course aims to provide students with an integrated understanding of the scientific disciplines within the Natural Sciences. The curriculum covers theories on how various scientific disciplines are integrated to advance the field of chemistry, including topics such as photosynthesis and food chains, the philosophy of science, logic, principles of decision-making, the scientific method, scientific attitudes and character development, the relationship between mathematics and natural sciences, biology, and the interconnectedness of each system, as well as the role of Natural Sciences in research and technological development. The learning activities are designed using a blended learning approach, combining face-to-face classroom instruction with online learning supported by the Besmart platform. Assessment for this course is based on several aspects, including attitude, participation, structured assignments, mid-semester exams, and final semester exams, each with different weightings.
10	FMI6202	Statistics	The course on Statistics encompasses the following topics: (1) the definition and role of Statistics; (2) methods of data collection and presentation; (3) computation and interpretation of measures of central tendency, measures of position, and

			measures of data dispersion; (4) fundamentals of probability theory; (5) distribution of random variables; (6) sampling theory; (7) parameter estimation; (8) hypothesis testing.
Basic Education Courses			
11	MDK6201	Education Science	This course delves into the fundamental principles of education and the basic concepts of educational science, along with their applications in educational practice. It encompasses the following areas: educational phenomena, historical perspectives on education, the essence of education and educational science, education as a system, and issues (educational challenges) within the context of educational reform (innovation).
12	MDK6202	Educational Psychology	This course explores the fundamental concepts of human phenomena within the field of education and their applications, encompassing the basic principles of educational psychology, forms of psychological phenomena, individual differences, learning and instruction, assessment of learning outcomes, and the diagnosis of learning difficulties.
13	MDK6203	Education Management	The course on Educational Management is a university-level course and is mandatory for students enrolled in education programs, carrying a weight of 2 credit units (SKS). This course discusses the fundamental concepts, roles, and scope of educational management, followed by an in-depth study on the management of various aspects within the field of educational management. These aspects include: students, curriculum, educational personnel, educational facilities, educational financing, institutional administration, relationships between educational institutions and the community, as well as educational leadership and educational supervision.
14	MDK6204	Sociology and Anthropology of Education	This course explores education as a socio-cultural process. It provides foundational knowledge on the significance of the environment, approaches, and socio-cultural influences, both from within schools and external factors (family, peer groups, national society, and mass media), in a multicultural (pluralistic) society. Additionally, it examines the most suitable educational framework for the

			Indonesian people (anthropos) in achieving the national educational objectives, both in the present and the future.
Learning Process Skills Course			
15	MPK6201	Chemistry Curriculum and Learning	Through this course, students are expected to comprehend the fundamental concepts of curriculum, the elements/components of curriculum, factors in curriculum development, curriculum development models, the National Education Standards (SNP), the currently applicable national curriculum, the chemistry curriculum in senior high schools (SMA) and its development, the curriculum spectrum and structure of vocational high schools (SMK), as well as to familiarize themselves with international and other countries' science/chemistry learning curricula.
16	MPK6202	Chemistry Learning Model	Through this course, students are expected to comprehend the concepts and types of approaches, methods, techniques, models, components of learning models, as well as the approaches and models that align with the applicable curriculum. Additionally, students should be able to analyze the differences among various learning models and make informed selections for chemistry instruction.
17	MPK6203	Chemistry Media and Learning Resources	In this course, the following topics will be discussed: the definition of instructional media, the roles and functions of instructional media, various types of instructional media, the planning and selection of instructional media, production techniques for instructional media, presentation techniques for instructional media, and the evaluation of instructional media, with a specific focus on chemistry education. Additionally, the course will cover the concepts, types, and quality of learning resources in chemistry.
18	MPK6204	Chemistry Learning Assessment	This course examines various terms commonly used in the assessment of chemistry learning outcomes, the paradigm shift in assessment and authentic assessment, targets (before, during, after), domains, techniques (test and non-test), and instruments for assessing chemistry learning outcomes. It also covers methods for developing assessment instruments for chemistry learning (both test and

			non-test), processing assessment results, and an introduction to the analysis of assessment instruments.
19	PEN6201	Micro Learning	The micro-teaching course is a practical learning course conducted in front of peers (peer teaching) in groups (each group consists of 7-10 students), with each group being guided by one or two competent lecturers in their respective fields. In this course, students develop teaching skills for guided teaching practice using specific learning models, reflect on the teaching they have conducted, and engage in at least one teaching practice session in English.
Education Development Course			
20	MPK6205	Chemistry Education Research Methodology	This course examines the principles of research methodology, encompassing issues, objectives, and benefits of educational research, types of educational research, research methods in quantitative approaches and an introduction to qualitative methods, developmental research, sampling techniques, research variables, as well as the practice of formulating research proposals in chemistry education.
21	MPK6206	Chemistry Education Research Instruments	This course equips students with practical skills in developing instruments to be used in chemistry education research. These instruments are designed to meet the criteria of high-quality research tools. Additionally, the course focuses on determining the validity and reliability of the instrument's constructs, facilitated by the use of specialized software.
22	MPK6213	Chemistry Education Research Data Analysis	The course that studies data analysis design, descriptive and univariate inferential statistical data analysis, which includes difference tests as well as parametric and nonparametric correlation tests, along with practical data analysis using software to support chemistry education research.
23	MPK6234	Chemistry Education Scientific Publications	This course examines various forms of scholarly writing, the methodology for composing research-based scientific articles, issues of plagiarism and intellectual property rights, as well as the process of publishing scientific articles and applying these practices.
Chemistry Education Scientific Course			

24	MPK6207	Chemistry Learning Research Review Latest	This course examines various emerging trends in chemistry education that are currently prominent issues in both Indonesian and global education contexts through the analysis of research articles from national and international journals. Students will conduct an in-depth exploration of specific topics aligned with their interests, which will subsequently form the basis of their final research project or thesis.
25	MPK6208	Learning Program Development Chemistry	This course is designed to equip students with the competence and skills to develop active, innovative, creative, engaging, and authentic chemistry learning programs based on the TPACK framework. The course content includes: preparing annual and semester programs, analyzing Core Competencies (KI), Basic Competencies (KD), Achievement Indicators (IPK), and subject matter, designing Lesson Plans (RPP) and their components with educational and contextual learning strategies, and adopting a student-centered approach.
26	MPK6209	Chemistry for High School	This course discusses concepts related to High School Chemistry (SMA/MA) for Grades X, XI, and XII in accordance with the applicable curriculum. It begins by examining the Core Competencies (Kompetensi Dasar/KD) of the current curriculum and elaborates these competencies into High School Chemistry (SMA/MA) materials. The course addresses chemistry concepts that are inaccurately or improperly conveyed in high school, including misconceptions, by analyzing instructional videos and reviewing high school chemistry textbooks used by students. It also explores analogies of chemistry concepts as well as inaccurate analogies. Additionally, the course focuses on lesson preparation and other teaching tools (such as Student Worksheets) that align with the essence of Chemistry as a science (Natural Science/IPA), which encompasses both process and product.
27	MPK6210	Chemistry for Vocational School	This course examines the structure of the curriculum in Vocational High Schools (SMK) and the chemistry material taught in SMK. The curriculum structure is studied in general,

			encompassing the differences between the curriculum structures of SMK and Senior High Schools (SMA), the spectrum of expertise in SMK, the position of chemistry subjects in SMK, and the principles of their development. The chemistry material covered includes topics that need to be strengthened by students according to their expertise programs in SMK.
28	MPK6211	Chemistry Visualization for Learning	This course examines the use of software to develop animation-based and simulation-based media for explaining and visualizing concepts of multiple representations in chemistry, the fundamentals of virtual laboratories, and augmented reality for chemistry education.
29	MPK6212	Context-Based Chemistry Learning	This course aims to present chemistry learning that is relevant to personal, social, and professional contexts. In this course, discussions will focus on the perspectives of context-based chemistry learning, the characteristics of context-based learning, modeling of context-based learning, the role of context in chemistry curriculum design, the use of Socio-Scientific Issues (SSI) and vocational expertise as contexts, as well as the challenges in designing context-based learning.
Science of Chemistry Course			
30	MKK6301	Basic Chemistry 1	This course discusses the fundamental concepts of chemistry, which encompass the scientific method, components of matter, stoichiometry and chemical reactions, states of gases, atomic structure, the periodic system of elements, chemical bonding, and organic compounds.
31	MKK6302	Basic Chemistry 2	This course discusses fundamental concepts of chemistry, including thermodynamics, kinetics, chemical equilibrium, acid-base equilibrium, ionic equilibrium in solutions, properties of solutions, electrochemistry, abundance of elements, and nuclear chemistry.
32	MKK6303	Math for Chemistry	This course includes learning about mathematical concepts and their applications in chemistry. These concepts include: coordinate systems, functions of one or more variables, differential-integral, differential equations, matrix-determinants, operators and vectors and data processing.

33	MKK6304	Chemistry Equilibrium	This course discusses the concepts of gases and their properties, the first law of thermodynamics and its applications, thermochemistry, the second and third laws of thermodynamics and their applications, chemical equilibrium, phase equilibrium, the physical properties of solutions, and electrochemical equilibrium.
34	MKK6305	Molecular Dynamics	This course studies molecular dynamics, which includes material on the theory of gas kinetics, molecules that move (including gases and solutions), chemical reaction rates (including: empirical chemical kinetics and explanation of rate laws), and macromolecules. The course includes theory and practicum in the laboratory.
35	MKK6306	Basic organic Chemistry	This course includes theory and practice which includes material: 1) Basic concepts of organic reactions, namely the structure of organic molecules, Kekule, Lewis, Pauling, resonant structures and conjugation, 2) structures, names, properties, oxidation reactions and mechanisms of substitution reactions and conformations of alkane compounds and cycloalkanes, 3) structures, structure, names, properties and mechanisms of addition reactions to alkenes and alkynes, 4) structure, names, properties and reaction mechanisms of halo alkane compounds, SN1/E1 and SN2/E2 and SNi, etc.
36	MKK6307	Structure and Reactivity Organic Compound	The structure and reactivity of organic compounds course contains concepts, structures, physical and chemical properties and reaction mechanisms in carbonyl compounds (aldehydes and ketones), amides, aromatic compounds, heterocyclic aromatics, stereochemistry, compounds with polyfunctional groups, carbohydrates, lipids, amino acids and proteins.
37	MKK6208	Structure Determination of Organic Compounds	This course encompasses the fundamental concepts of spectroscopy, the basic principles of UV, IR, NMR, and MS spectroscopy, as well as the elucidation of organic compound structures based on spectroscopic data.
38	MKK6309	Non-metallic Inorganic Chemistry	This course includes theory and practice which includes: atomic structure of hydrogen and polyatoms, periodic trend of elements, symmetry

			and molecular group theory, covalent bonding models (valence bond theory and molecular orbital theory), acid-base and donor-acceptor chemistry, chemical reactions (reduction-oxidation), and chemistry of non-metallic main groups.
39	MKK6310	Metallic Inorganic Chemistry	Inorganic Chemistry of Metals studies the concepts of metallic bonding, ionic bonding, properties, reactions, and applications of metals in the alkali group, alkaline earth group, aluminum, transition elements, lanthanides and actinides, tin and lead, iron corrosion and its prevention, as well as reactions in various types of batteries.
40	MKK6211	Coordination Chemistry and Organometallic	Coordination Chemistry and Organometallic Chemistry discuss the Chemistry of Transition Elements, Complex Compounds, the Concept of Effective Atomic Number, and the Valence Bond Theory (Hybridization), Crystal Field Theory (Ligand Field Theory), and Molecular Orbital Theory of Complex Compounds. Laboratory experiments involve Complex Compounds of Aluminum, Chromium, Iron, Cobalt, Nickel, and Copper with various ligands. Organometallic Chemistry covers the concepts and history of organometallic compounds, reaction mechanisms, examples of reactions involving some organometallic reagents and their applications, as well as the use of organometallic compounds in industry.
41	MKK6312	Fundamentals of Chemistry Analytical	Fundamentals of Analytical Chemistry consists of Qualitative and Quantitative Analysis Chemistry. Qualitative analysis is the identification of sample components with specific reagents. Quantitative analysis is the determination of the amount (grams, percent) by volumetric techniques.
42	MKK6313	Chemical Separation Method	This course examines the various principles of analytical separation, some influencing factors, methods of electrochemical separation and analysis and separation by membrane.
43	MKK6314	Chemistry Instrumentation	This course includes theory and practice in the laboratory which includes the scope of instrument chemistry, colorimetry, and various modern analytical methods such as spectrophotometry UV-VIS, FTIR, Mass, NMR, and SSA which are useful

			for conducting chemical research.
44	MKK6315	Biochemistry	This course examines the chemical structure, functions, and chemical processes within cells (the smallest units of living organisms), which include carbohydrates, lipids, proteins, enzymes, minerals, vitamins, and water in the chemical processes (metabolism) of carbohydrates, lipids, and proteins. It also discusses nucleic acids, genetic engineering, hormones, nutrition and food, as well as practical aspects of the properties and chemical reactions of carbohydrates, lipids, proteins, and enzymes.
45	MKK6216	Environmental Chemistry	This course examines the sources, reactions, transport, effects and effects of chemical species in the air, water and soil environments, as well as the influence of human activities on these processes.
46	MKK6217	Management Chemistry Laboratory	In this course, the material is studied (1) understanding, objectives and scope of laboratory management, (2) understanding and laboratory functions, (3) laboratory design and layout, (4) tool management, (5) material management, (6) tool selection criteria, (7) work safety in the laboratory, (8) assessment of learning activities in the laboratory, (9) laboratory waste management, (10) hazardous experiment techniques, and (11) MSDS.
47	MKK6218	Environmentally Friendly Materials Chemistry	The course on Environmentally Friendly Material Chemistry studies the concepts and development of environmentally friendly material chemistry, including polymers, to support ESD.
48	MKK6219	Chemistry Research	A course that studies the basic methods of chemical research and the practice of simple chemical research to be applied in the context of fostering scientific work activities in schools.
49	MKK6220	Fundamentals of Chemistry Computing	This course discusses computational chemistry methods, the strengths and weaknesses of each computational chemistry method, as well as the application of modeling simple molecules. The course encompasses the study of fundamental concepts in computational chemistry, which pertain to computational chemistry methods and their applications.
50	MKK6221	Chemistry Based Entrepreneurship	A course that equips students to develop business plans and practice chemistry-based small businesses or chemical education.

Out of University Study Program Courses			
51	MKL6601	Educational Practices	Educational practice refers to the activity of teaching chemistry subjects in senior high schools (SMA) or vocational high schools (SMK), as well as analyzing the challenges of various learning components in the field, teacher self-development, and the management of educational programs in schools.
52	MKL6604	KKN (Working College Real)	This course is a field course that is expected to be able to teach students to apply science and develop ethics in community life, provide solutions to problems in society appropriately by emphasizing the involvement of local wisdom and regional potential.
53	TAM6801	Thesis	This course equips students with the ability to analyze problems in the field of chemical education, design problem-solving solutions, conduct research, compile research reports in the form of a final thesis, reflect on the research process, and defend their work before an examination board. The entire process is carried out under the intensive guidance of a supervising lecturer.

Additional Course Description Strengthening Chemistry Education

No	Code	Course Name	Course Description
Chemistry Education Research			
1	MPK6218	Qualitative Research Chemistry Education	This course provides students with the ability to analyze problems in the field of chemical education, design problem-solving strategies, conduct research, compile research reports in the form of a final thesis, reflect on the research process, and defend their work before an examination panel. The entire process is conducted under the intensive supervision of an academic advisor.
2	MPK6219	Thematic Research Chemistry Education	This course discusses various documentary research methods, data collection and analysis, implementation of metaanalysis and systematic review in chemical education and compiles one simple thematic review article.
3	MPK6220	Action Research Chemistry Education	This course focuses on designing and preparing action research to address issues in chemistry learning. This course comprehensively discusses Classroom Action Research (CAR), including problem identification, action planning, instruments, data analysis, and reporting.

4	MPK6221	Multivariate Analysis Educational Research Chemistry	This course examines research design for multivariate data analysis such as MANOVA, MANCOVA, repeated measures ANOVA, multiple regression, and their practical application using software.
Relevance of Chemistry and Society Learning			
5	MPK6214	Strategy Trend Chemistry Learning	The course that studies the philosophy, concepts, and integration of STEM (Science, Technology, Engineering, and Mathematics) in chemistry education at senior high schools (SMA) and vocational high schools (SMK), designs STEM-based chemistry learning tools, produces examples of STEM products, and analyzes trends in approaches, models, and learning strategies that can be implemented in chemistry education.
6	MPK6125	Chemistry Experiment at School	This course explores the fundamentals of chemical experiments at the elementary and secondary school levels. It focuses on the design of chemical experiments in school-based learning, analyzing them from the perspectives of conceptual understanding, contextual relevance, and practical implementation in school settings. Additionally, the course examines various forms of applications of chemical experiments in educational practices within schools.
7	MPK6217	Chemistry Learning for Sustainable Development	This course examines the principles of Education for Sustainable Development (ESD) and their implementation in chemistry education, the principles of green chemistry and its integration into chemistry learning, as well as the concept of transformative education and its various aspects.
8	MPK6217	Chemical Literacy and the Environment	The course discusses the concepts and aspects of chemical and environmental literacy, how to develop them in learning, and the development of instruments to measure the levels of chemical and environmental literacy.
ICT Integration in Chemistry Learning			
9	MPK6222	Online Learning for Chemistry	The course encompasses the design of online chemistry education, both fully online and blended learning, which integrates asynchronous learning through a Learning Management System (LMS) and synchronous learning via video conferencing to achieve effective chemistry education. This course also explores the utilization and development of various LMS and the efficient packaging of online chemistry learning materials.
10	MPK6223	Development of Electronic Chemistry	This course equips students with the ability to develop teaching materials, such as modules, student worksheets, virtual laboratories, or electronic textbooks, by integrating chemical

		Learning Resources	modeling approaches and specific teaching models/methodologies.
11	MPK6224	Educational Games in Chemistry Learning	The course equips students with the ability to utilize and develop both traditional and digital games as educational tools in teaching chemistry at the high school level, as well as introductory chemistry media for middle school and elementary school students.
12	MPK6225	Social Media in Chemistry Learning	This course emphasizes the development and utilization of social media to introduce and educate the public about chemistry in relation to everyday life topics or popular issues, employing a social approach such as vodcasts.
Chemistry Pedagogy and School Management			
13	MPK6226	Thinking Strategies in Chemistry Learning	This course focuses on the study of Higher-Order Thinking Skills (HOTS) and thinking strategies, including argumentation skills, problem-solving skills, reasoning, and decision-making, as well as the development of instruments to measure these competencies.
14	MPK6227	English for Chemistry Classroom	This course prepares chemistry education students as prospective educators in bilingual educational institutions by equipping them with knowledge of general classroom conversation, English for learning, and communication in the field of chemistry education.
15	MPK6228	Management of Scientific Extracurricular at School	This course examines the management of youth scientific activities in schools, encompassing the stages of planning, organization, and evaluation, as well as the management of activities and students. Students are provided with an understanding that extracurricular activities play a significant role in fostering scientific engagement and development among young individuals.
16	MPK6229	History and Perspectives Chemistry	This course examines the development (history) of chemistry from prehistoric times to the early 20th century through a philosophical analysis of its historical progression, with an emphasis on how past chemists thought and worked while simultaneously developing, evaluating, and employing new theories and practical methods, as well as their applications in the process of teaching chemistry at the secondary school level.
Innovative Assessment of Chemical Learning			
17	MPK6230	Assessment Development Chemistry e-Learning	This course examines the components of chemistry learning assessment conducted online and utilizes various applications or software to develop assessment instruments in chemistry education.

18	MPK6231	Diagnostic Test in Chemistry Learning	The course discusses the types and formats of diagnostic tests, such as the identification of misconceptions, learning difficulties, and chemistry learning anxiety, as well as the development of effective assessments.
19	MPK6232	Affective and Character Assessment in Chemistry Learning	This course equips students with an understanding of the concepts of character education in Indonesia and other countries, the concepts of attitude assessment, and the development of measurement instruments.
20	MPK6233	Project Based Assessment in Chemistry Learning	This course explores the concept of project-based assessment and develops measurement instruments for evaluating the process, product, and creativity of projects carried out.