



Curriculum Handbook

2024-2028

Based on the Rector's Decree
Number: 3046 /UN11/KPT/2024

Master in Chemistry Program

Faculty of Mathematics and Natural Sciences
UNIVERSITAS SYIAH KUALA



CURRICULUM DOCUMENT MASTER IN CHEMISTRY PROGRAM



**UNIVERSITAS SYIAH KUALA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
DARUSSALAM 2024**

PROGRAM OVERVIEW

Program Specification

1	Name of Institution	Universitas Syiah Kuala
2	Name of Study Program	Master in Chemistry (MKIM)
3	Degree Level	Master
4	Address	Jl. Tgk. Syech Abdurrauf No. 3, Building B, Faculty of Mathematics and Natural Sciences, Kopelma Darussalam, Syiah Kuala District, Banda Aceh 23111, Indonesia
5	Accreditation Status:	Accredited with “Excellent” by LAMSAMA Decree No. 061/SK/LAMSAMA/Akred/M/XII/2022
6	Degree Title	Master of Science (M.Si)
7	Duration and Credit Load	2 years (4 semesters), 54 credits (SKS) (equivalent to approximately 90 ECTS)

PROGRAM DESCRIPTION

The Master in Chemistry Program (MKIM) was established in 2013 under the authorization of the Ministry of Education and Culture of the Republic of Indonesia, based on Decree No. 97/E/O/2013 dated April 12, 2013. The program began admitting new students in the odd semester of the 2013/2014 academic year. Initially, MKIM operated under the Postgraduate School of Universitas Syiah Kuala. Since 2018, it has been under the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Syiah Kuala. The program is located at Jln. Syech Abdurrauf No. 3, Kopelma Darussalam, Building B, FMIPA, Universitas Syiah Kuala (USK). MKIM is currently accredited “Excellent” (*Unggul*) by the Independent Accreditation Agency for Natural and Formal Sciences (LAMSAMA), under Decree No. 061/SK/LAMSAMA/Akred/M/XII/2022 dated December 21, 2022.

MKIM is the only graduate chemistry program in the Aceh Province that emphasizes the advancement and deepening of chemical sciences. The areas of study offered are designed to produce graduates who are highly competent, possess integrity, demonstrate innovative capabilities in advancing science and technology, and exhibit entrepreneurial spirit and strong intellectual and academic standards, as reflected in their profound knowledge and skills in chemistry. The program is divided into non-biological fields—including Physical Chemistry, Inorganic Chemistry, and Analytical Chemistry—and biological fields—including Organic Chemistry and Biochemistry.

The learning process at MKIM is supported by 21 full-time faculty members (Appendix 1), all of whom hold doctoral degrees. These faculty members include 9 professors, 10 associate professors, and 2 assistant professors. Their educational backgrounds include doctoral degrees from both international institutions—such as those in Germany, Japan, the Netherlands, the United Kingdom, Australia, and Malaysia—and leading domestic universities such as ITB, USU, and USK. The faculty members demonstrate strong performance in teaching, research, and community engagement. Additionally, MKIM is supported by three professional laboratory technicians who assist in research conducted by both faculty and students.

As of the 2023/2024 academic year, MKIM has graduated 84 Master's degree holders who have pursued careers across various sectors, including academia, research, industry, and public services. To complete the program, students must earn a minimum of 54 credits, in accordance with the Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia No. 53 of 2023. The program can be completed in as little as 1.5 years (3 semesters) and must be finished within a maximum of 4 years (8 semesters), with a minimum cumulative GPA of 3.00. Students are required to conduct research in their chosen field of interest as part of graduation requirements and must submit a thesis and produce at least one publication. Teaching and research activities are supported by adequate infrastructure, including classrooms, administrative offices, and well-equipped laboratories with advanced instrumentation. Student theses have resulted in various scientific outputs, including publications in reputable international journals, Scopus-indexed international proceedings, nationally accredited journals (SINTA), as well as registered patents and copyrights. MKIM welcomes students from diverse undergraduate backgrounds, including Chemistry, Chemistry Education, Pharmacy, and other relevant fields.

CURRICULUM DEVELOPMENT COMMITTEE DECREE



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KEPUTUSAN REKTOR UNIVERSITAS SYIAH KUALA

NOMOR No SK: 75/UN11.1.8/KPT/2024

TENTANG

PENUNJUKAN TIM PENYUSUN KURIKULUM OUTCOME BASED EDUCATION
(OBE) PADA PROGRAM STUDI MAGISTER KIMIA JURUSAN KIMIA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS SYIAH KUALA

REKTOR UNIVERSITAS SYIAH KUALA,

- Menimbang :
- a. bahwa untuk kelancaran pelaksanaan kegiatan Penyusunan Kurikulum Outcome Based Education (OBE) pada Program Studi Magister Kimia Jurusan Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Syiah Kuala, maka perlu ditunjuk Tim Penyusun yang bertugas untuk itu;
 - b. bahwa untuk keperluan dimaksud, perlu ditetapkan dengan Keputusan Rektor;
- Mengingat :
1. Undang-Undang Nomor 17 Tahun 2003 tentang Keuangan Negara;
 2. Undang-Undang Nomor 1 Tahun 2004 tentang Perbendaharaan Negara;
 3. Undang-Undang Nomor 12 Tahun 2012 tentang Pendidikan Tinggi;
 4. Undang-Undang Nomor 19 Tahun 2023 tentang Anggaran Pendapatan dan Belanja Negara Tahun Anggaran 2024;
 5. Peraturan Pemerintah Nomor 4 Tahun 2014 tentang Penyelenggaraan Pendidikan Tinggi dan Pengelolaan Perguruan Tinggi;
 6. Peraturan Pemerintah Nomor 38 Tahun 2022 tentang Perguruan Tinggi Negeri Badan Hukum Universitas Syiah Kuala;
 7. Peraturan Menteri Keuangan Nomor 49 Tahun 2023 tentang Standar Biaya Masukan Tahun Anggaran 2024;
 8. Peraturan Rektor Nomor 5 Tahun 2024 tentang Organisasi dan Tata Kerja Unsur Rektor Universitas Syiah Kuala;
 9. Keputusan Rektor Universitas Syiah Kuala Nomor 6002/UN11/KPT/2023 tentang Pemberhentian/Pengangkatan Dekan Fakultas MIPA Universitas Syiah Kuala periode 2023-2026;
 10. Keputusan Rektor Universitas Syiah Kuala Nomor 1470/UN11/KPT/2024 tentang Pelimpahan Kewenangan Penandatanganan Keputusan Rektor Kepada Wakil Rektor, Ketua Lembaga, Dekan, dan Direktur Sekolah Pascasarjana Universitas Syiah Kuala;

MEMUTUSKAN:

- Menetapkan : KEPUTUSAN REKTOR TENTANG PENUNJUKAN TIM PENYUSUN KURIKULUM OUTCOME BASED EDUCATION (OBE) PADA PROGRAM STUDI MAGISTER KIMIA JURUSAN KIMIA FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNIVERSITAS SYIAH KUALA.
- KESATU : Menunjuk Saudara-saudara yang namanya tercantum pada daftar lampiran keputusan ini sebagai Tim Penyusun kegiatan Penyusunan Kurikulum Outcome Based Education (OBE) pada Program Studi Magister Kimia Jurusan Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Syiah Kuala.
- KEDUA : Kegiatan ini dilaksanakan pada bulan Januari 2024 sampai dengan bulan Juni 2024.
- KETIGA : Segala biaya yang diakibatkan oleh keluarnya keputusan ini dibebankan pada Anggaran PTNBH Universitas Syiah Kuala Tahun Anggaran 2024 SUKPA Fakultas Matematika dan Ilmu Pengetahuan Alam yang sesuai dengan Peraturan Keuangan.
- KEEMPAT : Keputusan ini mulai berlaku pada tanggal 2 Januari 2024 dan apabila dalam penetapan ini kemudian ternyata terdapat kekeliruan akan diperbaiki kembali sebagaimana mestinya.

Ditetapkan di Banda Aceh
pada tanggal 16 April 2024

a.n. REKTOR UNIVERSITAS SYIAH KUALA,
DEKAN FAKULTAS MATEMATIKA DAN ILMU
PENGETAHUAN ALAM



Prof. Dr. Taufik Fuadi Abidin, S.Si., M.Tech
NIP 197010081994031002

LAMPIRAN
KEPUTUSAN REKTOR UNIVERSITAS SYIAH KUALA
NOMOR No SK: 75/UN11.1.8/KPT/2024, TANGGAL 16 APRIL 2024
TENTANG
PENUNJUKAN TIM PENYUSUN KURIKULUM OUTCOME BASED EDUCATION
(OBE) PADA PROGRAM STUDI MAGISTER KIMIA JURUSAN KIMIA FAKULTAS
MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNIVERSITAS SYIAH
KUALA

No	Nama/NIP/NIPK	Pangkat/Gol	Jabatan dalam Dinas	Jabatan dalam Panitia	Rincian Tugas	Tugas dan Fungsi
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2	Prof. Dr. Ika Sufitri, S.Si., M.Si 197001052000032001	Pembina Utama Muda (Gol. IV/c)	Guru Besar	Ketua	Mengkoordinir kegiatan penyusunan bahan kajian, mata kuliah, CPMK dan bobot SKS per mata kuliah di Prodi Magister Kimia	Tidak
3	Dr. Nurhaida, S.Si, M.Si 197003301999032005	Pembina Utama Muda (Gol. IV/c)	Lektor Kepala	Sekretaris	Mengkoordinir kegiatan penyusunan Kode Mata Kuliah, Prasyarat, Struktur Kurikulum dan Daftar Ekuivalensi Mata Kuliah di Prodi Magister Kimia	Tidak
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6	Prof. Dr. Binawati Ginting, S.Si., M.Si 197209271999032002	Pembina (Gol. IV/a)	Guru Besar	Anggota	Mengkoordinir penyusunan Mata Kuliah Bidang Hayati Kimia Organik	Tidak
7	Dr. Khairi, S.Si., M.Si 196906141999031002	Pembina (Gol. IV/a)	Ketua Jurusan Kimia	Anggota	Mengkoordinir penyusunan Mata Kuliah Bidang Non Hayati Kimia Analitik	Tidak
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10	Maizar Adh-Dhuha, S.Si. 19940527202051101	-	Pengadministrasi Akademik	Anggota	Membantu tugas ketua dan sekretaris dalam penyusunan dokumen kurikulum	Tidak

Disetujui di Banda Aceh
pada tanggal 16 April 2024

u.n. REKTOR UNIVERSITAS SYIAH KUALA,
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UNIVERSITAS
SYIAH KUALA



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PREFACE

The development and revision of a curriculum are critical steps in ensuring the academic quality of a study program. This process aims to equip students with competencies aligned with advancements in science and technology, while also preparing them to respond to increasingly complex and competitive challenges in the global era. In this context, it is essential to align the curriculum with current trends, including the technological shifts of the Fourth Industrial Revolution, the *Merdeka Belajar Kampus Merdeka* / Independent Learning Independent Campus (MBKM) policy, Ministry of Education Regulation No. 53 of 2023 on Quality Assurance in Higher Education, and the institutional transformation of Universitas Syiah Kuala as a State Higher Education Institution with Legal Entity (*Perguruan Tinggi Negeri Badan Hukum*– PTNBH) status.

Curricular reform across all study programs within the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Syiah Kuala (USK), adopts the Outcome-Based Education (OBE) approach. This framework ensures that the curriculum is designed to achieve clearly defined and measurable learning outcomes. In an OBE-based curriculum, every aspect of instruction is structured to align with specific and relevant goals, particularly those that reflect real-world professional demands. Consequently, the curriculum design, assessment strategy, and instructional process are all oriented toward the attainment of predetermined learning outcomes.

The current development of the OBE curriculum has been guided by a range of considerations, including Ministry Regulation No. 53 of 2023, the Indonesian National Qualifications Framework (KKNI), MBKM policies, technological and scientific advancements, as well as input from professional associations, government bodies, industry stakeholders, and alumni. Nevertheless, we acknowledge that the curriculum may still have room for improvement. Therefore, we sincerely welcome constructive feedback and recommendations for its future refinement.

We extend our deepest gratitude to department leaders, program coordinators, curriculum development teams, and all parties who have contributed and provided support throughout the process of curriculum revision. We hope that this newly developed curriculum will bring substantial benefits to students and graduates of FMIPA USK.

Darussalam, May 6, 2024

Dean,

Prof. Dr. Taufik Fuadi Abidin, S.Si., M. Tech.

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CHAPTER 1

INTRODUCTION

The Master in Chemistry Program (MKIM) is a graduate-level academic program in Aceh that focuses on the in-depth study and development of pure chemistry. The establishment of MKIM was authorized by the Decree of the Minister of Education and Culture (*KepMendikbud*) No. 97/E/O/2013, dated April 12, 2013. The 2024 Outcome-Based Education (OBE) Curriculum of the Master in Chemistry Program has been developed in accordance with the procedures set by Universitas Syiah Kuala, as outlined in the 2024 Curriculum Development Manual and Standard Curriculum Format. In the curriculum development process, MKIM engaged multiple stakeholders, including scientific associations, subject-matter experts, employers, alumni, and through benchmarking with similar programs at other institutions.

1.1 Curriculum Development Process

The curriculum of the Master in Chemistry Program (MKIM) is developed based on the program's vision, mission, and goals, aligned with those of the Faculty of Mathematics and Natural Sciences (FMIPA) and Universitas Syiah Kuala (USK). The curriculum follows an Outcome-Based Education (OBE) approach, which emphasizes the attainment of clearly defined and measurable learning outcomes—namely knowledge, skills, and attitudes that reflect real-world impact. OBE represents a shift from the traditional credit-based system to a curriculum, assessment, and reporting structure centered on high-level learning achievement. The development of the OBE-based curriculum at MKIM follows these stages:

1. The study program holds regular meetings to form a curriculum development committee. The committee reviews relevant laws, regulations, and curriculum guidelines from both the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) and USK.
2. The committee analyzes survey results to determine graduate profiles.
3. A tracer study is conducted to collect feedback from alumni, employers, partners, and relevant academic associations (e.g., the Indonesian Chemical Society).
4. The curriculum team and heads of study fields identify core subject areas, Intended Learning Outcomes (ILO), and Course Learning Outcomes (CLO).
5. Identified learning outcomes are reviewed and finalized in program meetings to determine the list of courses.
6. Courses are structured and distributed across semesters, followed by the development of syllabi (RPS), course contracts, and assessment rubrics.
7. The draft curriculum layout is submitted to the Directorate of Education and Learning (*Direktorat Pendidikan dan Pembelajaran/DPP*) of USK for review.
8. The draft curriculum layout is submitted to the Directorate of Education and Learning (*Direktorat Pendidikan dan Pembelajaran/DPP*) of USK for review.

The development of the 2024 curriculum involved various stakeholders through activities such as tracer studies, seminars, workshops, and focus group discussions (FGDs), conducted both online and offline. Table 1.1 presents the list of activities involving stakeholders from multiple sectors throughout the curriculum development process.

Table 1.1. Stakeholder involvement in the obe-based curriculum revision of the Master in Chemistry Program (MKIM)

No	Type of Activity	Speaker(s)/Facilitator(s)	Date
1	OBE-Based Curriculum Development Workshop – FMIPA	Prof. Dr. Ir. Remon Lapisa, S.T., M.T., M.Sc (Universitas Negeri Padang)	3-4 November 2023
2	OBE-Based Course Design (RPS) Workshop – USK	USK Curriculum Development Team	18 November 2023
3	Curriculum Guidelines Socialization within USK	USK Curriculum Development Team	13 December 2023
4	Focus Group Discussion (FGD) on Tracer Study Data Analysis	Dr. Teuku Roli Ilhamsyah Putra, SE, MM Prof. Dr. Teuku M. Iqbalsyah, S.Si., M.Sc	7 February 2024
5	Training on Strengthening OBE-Based Semester Learning Plan (RPS) Development	USK Curriculum Development Team	5 March 2024
6	Finalization Workshop for the OBE-Based Curriculum Document	Dr.rer.nat. Fajar Rakhman Wibowo, S.Si., M.Si (Universitas Sebelas Maret, Solo)	16 March 2024
7	Focus Group Discussion (FGD) for Gathering Input from Stakeholders and Alumni	Stakeholders, Employers, and Alumni of MKIM	23 March 2024

1.2 Curriculum Evaluation and Tracer Study

A. Results of Curriculum Implementation Evaluation

Evaluation of the curriculum implementation is conducted annually by the MKIM, FMIPA USK, based on the results of tracer studies and surveys on employer satisfaction. The surveys are conducted online using a questionnaire that integrates three components: (1) the national tracer study questionnaire (Dikti), (2) the Indotrace questionnaire, and (3) institutional-specific needs of Universitas Syiah Kuala.

The tracer study targeted graduates from the 2021 and 2022 cohorts, assuming they completed their studies under the 2021 curriculum. Graduates from the class of 2023 were not included, as they had not reached one year post-graduation at the time of the study. A total of 21 graduates responded, resulting in a 100% completion rate. Survey results show that 76.9% of respondents were employed, 5.1% continued their studies, and 7.7% pursued entrepreneurship, while 10.3% were still seeking employment one year after graduation.

Among the respondents, 63.6% secured employment within three months after graduation; 17.9% were employed within six months, while the remaining 17.9% took more than 1.5 years to secure employment. Regarding the employment sector, 22.2% of respondents were employed in private companies, 33% in government

institutions, and 44.4% in other sectors. The majority (77.8%) were employed in the education sector, followed by 7.4% in scientific and technical professional services. The most significant factors in recruitment decisions were personal attributes and ICT (Information and Communication Technology) skills, followed by work experience and university reputation. Undergraduate study program, foreign language proficiency, and organizational experience were ranked as the third most important factors. Grade Point Average (GPA) and recommendation letters were perceived as less important in the recruitment process.

B. Foundations for Curriculum Revision

1. Stakeholder Needs Identified through Tracer Study

Assessing the needs of stakeholders is essential to evaluating employer satisfaction with the competencies of MKIM graduates. The results of the stakeholder survey indicate that graduates possess strong hard skills; however, their soft skills—particularly foreign language proficiency—require further improvement. Based on this feedback, stakeholders recommend that greater emphasis be placed on developing the soft skills of graduates. This finding has encouraged the PSMKIK to reorient and revise its curriculum in order to enhance both the hard and soft competencies of its graduates.

2. Changes in Internal and External Policies

Several external policies have served as the foundation for curriculum reform. These include the Presidential Regulation of the Republic of Indonesia No. 8 of 2012 concerning the Indonesian National Qualifications Framework (Ind:KKNI), which provides a national reference for graduate competencies. Additionally, the Ministry of Research, Technology, and Higher Education Regulation No. 44 of 2015 on the National Standards of Higher Education sets the baseline for academic program standards. This was further refined by the Ministry of Education and Culture Regulation No. 3 of 2020, and most recently by the Ministry of Education, Culture, Research, and Technology Regulation No. 53 of 2023, which emphasizes quality assurance in higher education. Together, these policies form a comprehensive framework guiding curriculum development and quality enhancement in Indonesian universities.

In alignment with these external directives, the Rector of Universitas Syiah Kuala issued Decree No. 6102/UN11/KPT/2023 regarding the 2024–2028 Curriculum Development Guidelines. The university's mandate to implement Outcome-Based Education (OBE) further supports and justifies the need for curriculum revision within MKIM.

3. Scientific and Technological Advancements

Curriculum reform within the MKIM is also a response to rapid developments in science and technology, particularly those relevant to the field of chemistry. The curriculum is expected to prepare students to adapt to the demands of the 21st century, including active participation in the Fourth Industrial Revolution (Industry 4.0) and preparation for the upcoming Fifth Industrial Revolution (Industry 5.0). In this context, data literacy and technological proficiency are

critical components in shaping graduates who are responsive to current and future challenges. The integration of these elements into the curriculum ensures its relevance and responsiveness to scientific progress.

4. Alignment with the Sustainable Development Goals (SDGs)

Universitas Syiah Kuala, as part of its commitment to sustainable development, seeks to strengthen its contributions in the areas of education and research. The curriculum of MKIM is expected to incorporate SDG-oriented content into course materials and learning outcomes. Several courses, learning topics, and thesis research projects within the program have already supported the advancement of multiple SDG targets, including but not limited to: (1) No Poverty; (2) Zero Hunger; (3) Good Health and Well-being; (4) Quality Education; (5) Gender Equality; (6) Clean Water and Sanitation; (7) Affordable and Clean Energy; (8) Decent Work and Economic Growth; (9) Industry, Innovation, and Infrastructure; (10) Reduced Inequalities; (11) Sustainable Cities and Communities; (12) Responsible Consumption and Production; (13) Climate Action; (14) Life Below Water; (15) Life on Land; (16) Peace, Justice, and Strong Institutions.

5. Alignment with USK's Vision, Mission, and Curriculum Priorities

Curriculum revision is an integral part of fulfilling the university's commitment to the *Tridharma* of higher education. It reflects the vision of Universitas Syiah Kuala to become an innovative, independent, and globally recognized *socio-technopreneur* university. In accordance with its mission, the university aims to support regional and national development through local resource-based education and research. The curriculum is therefore designed not only to enhance academic quality, but also to produce highly competitive graduates capable of applying quality management in education and responding to global challenges.

6. Alignment with the Faculty's Vision and Mission

Curriculum improvement also directly supports the vision of FMIPA of becoming a globally recognized *socio-sciencepreneur* faculty by 2035. Through this vision, the revised curriculum of MKIM is expected to produce graduates who are excellent, independent, knowledgeable, creative, and innovative, with a strong sense of integrity and a *socio-sciencepreneurial* mindset for advancing science and technology.

C. Summary of Curriculum Revisions

Several key revisions have been made and implemented in the 2024 Outcome-Based Education (OBE) curriculum, including:

1. Strengthening of the graduate profile by incorporating entrepreneurial competencies. Core subject areas have been enhanced with reference to the Royal Society of Chemistry (RSC) framework and aligned with international accreditation standards such as ASIIN.

2. Revision of several Course Learning Outcomes (CLO) to better reflect the vision and mission of Universitas Syiah Kuala (USK), FMIPA, and the Master in Chemistry Program .
3. Modification of course structure, particularly to accommodate the additional 18 credits required to meet the new minimum total of 54 credits for Master's programs, in accordance with the Ministry of Education, Culture, Research, and Technology Regulation No. 53 of 2023 (previously 36 credits).
4. Transition of the Semester Learning Plan (RPS) format from a conventional model to one based on the principles of Outcome-Based Education (OBE).

1.3 Legal Foundations for Curriculum Design and Development

The design and development of the curriculum are guided by the following regulations and institutional policies:

- A. Regulation of the Minister of Education and Culture No. 3 of 2020 on the National Standards of Higher Education, along with relevant guidelines from the *Curriculum Development Guide for Higher Education in the Era of the Industrial Revolution 4.0*, published by the Directorate General of Higher Education, Ministry of Education and Culture, in 2020.
- B. Regulation of the Minister of Education, Culture, Research, and Technology No. 53 of 2023 on Quality Assurance in Higher Education.
- C. Rector's Decree No. 6102/UN11/KPT/2023 on the Official Curriculum Development Guidelines of Universitas Syiah Kuala for the 2024–2028 period.
- D. Other relevant legal frameworks and institutional policies.

CHAPTER 2

ACADEMIC VISION, GOALS, AND STRATEGIC DIRECTIONS OF THE PROGRAM

2.1 Academic Vision and Mission of the Study Program

2.1.1 Academic Vision

The MKIM, as an institution devoted to education and research, has formulated a vision that serves as the basis for achieving its objectives. This vision is aligned with those of Universitas Syiah Kuala (USK) and the Faculty of Mathematics and Natural Sciences (FMIPA). The correspondence among the visions of MKIM, FMIPA, and USK is presented in Table 2.1.

Table 2.1. Alignment of the Vision of the Study Program, Faculty, and Universitas Syiah Kuala

Vision of Program	Vision of the Faculty	Vision of University
To become an innovative and independent graduate program that advances education, research, and community engagement in the field of chemical sciences, emphasizing the utilization of local natural resources and fostering a socio-sciencepreneurial spirit, in order to achieve global competitiveness by 2035	To become an innovative, independent, and globally recognized socio-sciencepreneur faculty by 2035	To become an innovative, independent, and globally recognized socio-technopreneur university

Table 2.2. Checklist of Vision Alignment between MKIM and USK/FMIPA

Keywords in the Vision of the Program	Alignment of the Vision (tick ✓ as appropriate)		Description of Alignment
	Keywords in the Vision of the Faculty	Keywords in the Vision of USK	
Sciencepreneur	✓	✓	Aligned with disciplinary focus
Innovative	✓	✓	Aligned
Independent	✓	✓	Aligned
Globally Recognized	✓	✓	Aligned
Local Natural Resources			A specific orientation of MKIM

2.1.2 Mission of the Study Program

The mission of MKIM reflects its institutional goals of advancing academic quality, producing high-caliber graduates, and expanding national and international collaborations. The specific missions of the study program are as follows:

1. To produce graduates who are excellent, independent, diligent, creative, innovative, entrepreneurial, and possess integrity in advancing chemical science and technology.
2. To enhance and expand access to high-quality education, research, and academic services in the field of chemistry, with a strong emphasis on the utilization of local resources.
3. To strengthen national and international partnerships in order to generate impactful works recognized at both national and global levels.

2.2 Program Objectives

The educational, research, and community service goals of MKIM are closely aligned with the visions and missions of FMIPA and USK. The goals include:

1. To advance research and serve as a partner for society in the field of chemistry, prioritizing the utilization and management of local natural resources.
2. To facilitate social transformation through research and community engagement, contributing to regional development.
3. To encourage the creation of new employment opportunities as a follow-up to research implementation.
4. To enhance professional services in the field of chemistry by strengthening subject-matter expertise.

2.3 Strategic Directions

To achieve its vision, mission, and goals in alignment with FMIPA and USK, MKIM has established several strategic targets:

1. Enhancement of learning quality, with performance indicators including reduced average time to degree, shorter waiting period for employment (≤ 6 months), sustained high GPA, and an increase in the percentage of graduates employed immediately upon graduation.
2. Improved relevance, productivity, and competitiveness in research and community engagement, measured by an increase in the number of international publications, registered intellectual property, and community service activities based on research outputs.
3. Strengthening of student development, reflected in the growing number of nationally and internationally recognized student achievements, student entrepreneurship, and consistent rates of scholarship recipients.
4. Revitalization of institutional support for education, research, and community service — the core missions of higher education in Indonesia (*Tridharma*) — with performance indicators including an increased percentage of study programs accredited as “Excellent,” an appropriate faculty-to-student ratio, a higher proportion of faculty members holding the ranks of Professor and Associate Professor, and improved budget absorption.

2.4 University Core Values

The core values embraced by Universitas Syiah Kuala, referred to as *nilai ke-USK-an* (USK’s core values), are grounded in national and institutional principles. These include Pancasila, sincerity, honesty, and solidarity, as stated in Article 7 of Government Regulation No. 38 of 2022.

CHAPTER 3

GRADUATE PROFILE AND COMPETENCY STANDARDS

The 2024 curriculum of the Master in Chemistry Program (MKIM) was developed based on several key components, including the Graduate Profile (PL), Intended Learning Outcomes (ILO/ILO), Body of Knowledge (BK), Course Learning Outcomes (CLO/ CPMK), course distribution or course structure, and the equivalence between the 2021 and 2024 curricula. Several matrices were constructed to demonstrate the interrelation among these components. These include the matrix linking the Graduate Profile to the ILO, the matrix linking Subject Areas to the ILO, the matrix linking Course Learning Outcomes to Subject Areas, the matrix linking ILO to courses, and the matrix linking CPMK to individual courses. The sections below elaborate on each of these components in the context of the MKIM curriculum..

3.1 Graduate Profile and Description

The graduate profile of MKIM was formulated based on the results of tracer studies on alumni roles, current labor market demands, and the advancement of science and technology. The employment needs across government institutions, business sectors, and industry, along with the needs in knowledge development, served as the foundation for shaping the program's graduate profile. To identify stakeholder needs, the program conducted surveys among employers, alumni, and institutional partners. In addition, input from peer study programs was gathered through the Indonesian Chemical Society (Himpunan Kimia Indonesia, HKI).

The results of a tracer study involving 35 MKIM alumni revealed that most graduates work in academia, either as lecturers or other types of educators. Other employment sectors include private and governmental institutions, primarily as researchers. The alumni are also employed in industrial settings and as practitioners in various professional sectors.

Further analysis of feedback from alumni users indicated that MKIM graduates generally demonstrate adaptability in the workplace, high levels of integrity, social awareness, the ability to collaborate effectively, and a commitment to their religious values. Graduates are considered to have sufficient creativity and innovation skills, proficiency in operating and analyzing data from scientific instrumentation, and the ability to apply their chemical knowledge effectively. The survey also showed that the graduates possess relatively strong theoretical understanding. Despite these strengths, several areas were identified as needing improvement. These include foreign language proficiency—particularly in English—relatively low salary levels, the concentration of graduates in academic roles, and a number of alumni who are not yet employed. Based on the tracer study analysis and feedback from alumni and peer programs, MKIM, FMIPA, and USK have defined the following graduate profiles:

1. Academics
2. Researchers
3. Industrial and public sector practitioners

Table 3.1. Graduate Profile Description

Graduate Profile Code	Graduate Profile Competency Description	Components of Learning Outcomes (LO)	Relevant Professional Fields
PL-01	Graduates demonstrate integrity and respect for spiritual values, possess strong scientific competencies in chemistry (scientific skills), demonstrate social character (social skills), communicate effectively (communication skills), and uphold scientific norms. They also exhibit a commitment to lifelong learning.	S + KU + KK + P	1. Academics 2. Researchers 3. Industrial and public sector practitioners
PL-02	Graduates demonstrate pedagogical competence by mastering scientific principles in research design and implementation. They are proficient in using technology and capable of analyzing research results for the purpose of preparing scientific reports.	S + KU + KK + P	
PL-03	Graduates possess adaptability in applying scientific knowledge and in various work environments. They also demonstrate managerial, social, and communication skills, as well as proficiency in technology use.	S + KU + KK + P	

Legend:

S = Attitude (*Sikap*)

KU = General Skills (*Keterampilan Umum*)

KK = Specific Skills (*Keterampilan Khusus*)

P = Knowledge Competency (*Penguasaan Pengetahuan*)

3.2 Elements of Intended Learning Outcomes (ILO)

The formulation of MKIM's Intended Learning Outcomes (ILO) is grounded in a comprehensive analysis of feedback gathered through surveys involving alumni, employers, and peer master's programs in chemistry across Indonesia. These outcomes have been designed to align with competencies relevant to the Fourth Industrial Revolution (Industry 4.0) and are forward-looking in anticipation of emerging demands in Industry 5.0. Additionally, the ILOs are developed with reference to the National Standards for Higher Education (SN-Dikti) and the descriptors outlined in the Indonesian National Qualifications Framework (KKNI) at Level 8, while also placing strong emphasis on the utilization and development of local natural resources. The legal and regulatory foundations for the development of the ILOs are derived from several key documents: Presidential Regulation of the Republic of Indonesia No. 8 of 2012 concerning the Indonesian National Qualifications Framework (KKNI); Ministry of Research, Technology, and Higher Education Regulation No. 44 of 2015, specifically Article 5, on the National Standards of Higher Education; Ministry of Education and Culture Regulation No. 3 of 2020; and Ministry of Education, Culture, Research, and Technology Regulation No. 53 of 2023 on Quality Assurance in Higher Education. These regulations define four core components that form the foundation of graduate learning

outcomes: attitudes (S), general skills (KU), specific skills (KK), and knowledge competency (P).

The final formulation of the MKIM ILO—detailed in Table 1, Appendix 2—was developed through the following stages:

1. Identifying the needs of the university, faculty, and program based on their respective visions, missions, and graduate profiles
2. Conducting benchmarking activities through website reviews and focus group discussions with national peer program associations, international institutions such as the Royal Society of Chemistry (RSC), and international accreditation bodies such as ASIIN, in order to map out relevant Bodies of Knowledge and required competencies.
3. Assessing the needs of local and national communities
4. Reviewing the expectations of students and inputs from the alumni association.
5. Analyzing stakeholder expectations through advisory board input, which includes members from outside the university, as mandated by the 2023 Curriculum Development Guidelines of Universitas Syiah Kuala
6. Interpreting government regulations issued by the Ministry of Education and other relevant bodies.
7. Reformulating the ILO to comply with both national and international accreditation criteria.

Table 3.2 Mapping of Graduate Profiles (PL) to Intended Learning Outcomes (ILO)

Graduate Profile Code	ILO Code	Deskripsi ILO
PL-01	ILO01	To have a sense of piety, ethical conduct, integrity, social consciousness, an innovative mindset, and a commitment to lifelong learning in accordance with academic standards.
	ILO02	To effectively manage research, make informed decisions, communicate effectively, and engage in intercultural collaboration to address complex problems.
	ILO03	To independently design and conduct innovative research aimed at addressing complex problems, and to produce work that receives national or international recognition.
	ILO04	To possess comprehensive knowledge of chemistry, encompassing both specialized and interdisciplinary domains, to promote the development and application of original ideas.
PL-02	ILO01	To have a sense of piety, ethical conduct, integrity, social consciousness, an innovative mindset, and a commitment to lifelong learning in accordance with academic standards..
	ILO02	To effectively manage research, make informed decisions, communicate effectively, and engage in intercultural collaboration to address complex problems.
	ILO03	To independently design and conduct innovative research aimed at addressing complex problems, and to produce work that receives national or international recognition.
	ILO04	To possess comprehensive knowledge of chemistry, encompassing both specialized and interdisciplinary domains, to promote the development and application of original ideas.
PL-03	ILO01	To have a sense of piety, ethical conduct, integrity, social consciousness, an innovative mindset, and a commitment to lifelong learning in accordance with academic standards.

	ILO02	To effectively manage research, make informed decisions, communicate effectively, and engage in intercultural collaboration to address complex problems.
	ILO03	To independently design and conduct innovative research aimed at addressing complex problems, and to produce work that receives national or international recognition.
	ILO04	To possess comprehensive knowledge of chemistry, encompassing both specialized and interdisciplinary domains, to promote the development and application of original ideas.

3.3 Determination of Body of Knowledge

The formulation of MKIM's Intended Learning Outcomes (ILO) requires the inclusion of relevant subject areas within the field of chemistry to ensure that the intended competencies are effectively supported. Based on an in-depth analysis and comparison of multiple reference sources—including the Royal Society of Chemistry (RSC), the Indonesian Chemical Society (HKI), tracer surveys, and international accreditation standards such as ASIIN—the core subject areas for the Master in Chemistry Program are presented in Table 2 (Appendix 3).

The identification of these subject areas is essential to establish clear links between the ILOs and the chemistry domains, enabling a more structured formulation of Course Learning Outcomes (CLO) and course offerings.

Table 3.3 Mapping of ILO to Body of Knowledge

ILO Code	Body of Knowledge Code	Body of Knowledge Description
ILO04	BK-01	Structure, properties, energetics, and kinetics of chemical compounds
ILO02	BK-02	Techniques for the isolation, purification, and characterization of chemical compounds
ILO03		
ILO04		
ILO02	BK-03	Synthesis/biosynthesis and its engineering to produce useful chemical and biomolecular products
ILO04		
ILO01	BK-04	Contemporary chemical research for societal well-being
ILO02		
ILO03		
ILO04		
ILO01	BK-05	Innovative scientific research
ILO02		
ILO03		
ILO04		

3.4 Formulation of Course Learning Outcomes (CLO)

The Course Learning Outcomes (CLO) of the MKIM curriculum are developed based on the subject areas previously identified. These CLO are categorized into two main domains: biological and non-biological chemistry. The non-biological domain includes physical chemistry, inorganic chemistry, and analytical chemistry, while the biological domain encompasses organic chemistry and biochemistry. Each CLO is closely linked to specific courses within the curriculum and is developed to reflect both the depth and breadth of knowledge as defined by the Level 8 descriptors of the Indonesian National Qualifications Framework (KKNI). The complete list of CLO for MKIM can be found in Table 3 (Appendix 4).

3.5 Course Development

Courses are established through a matrix-based analysis of the relationships between ILO, subject areas, and CLO. Based on this comprehensive alignment, individual courses and their corresponding credit weights (SKS) are determined. The number of credits assigned to each course is guided by the scope and depth of the learning content, the complexity of the competencies addressed, and the overall learning workload required to achieve the expected outcomes. The full structure of courses and credit allocations for the 2024 Master's Curriculum in Chemistry is presented in the following section.

Course Code	Course Title	No. of CLO	Estimated Student Workload		Credits (SKS)
			Theory	Laboratory	
MMKM1001	Quantum Chemistry and Spectroscopy	4	5,66 hour/week x 16 weeks = 90,56 hours	0	2*
MMKM1003	Inorganic Chemical Reactions	2	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM1005	Recent Methods in Chemical Separation	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM1007	Reaction Mechanism in Organic Chemistry	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM1009	Metabolic Engineering	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
FPPS1001	Research Methodology	4	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM1011	Laboratory Management	1	5,66 hour/week x 16 weeks = 90,56	0	2

			hours		
MMKM1002	Chemistry in Halal Products	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM1004	Capita Selecta	3	0	8,19 hours/ weeks x 16 weeks = 131,04 hours	3**
MMKM1006	Colloquium of Analytical Methods	3	0	5,46 hour/week x 16 weeks = 87,36 hours	2
MMPAP001	Thesis Proposal	4	0	5,46 hour/week x 16 weeks = 87,36 hours	2
MMKMP003	Scientific Seminar	2	0	5,46 hour/week x 16 weeks = 87,36 hours	2
MMKMP004	Scientific Publication	4	0	8,19 hours/ weeks x 16 weeks = 131,04 hours	3
MMPAPA01	Thesis	6	0	21,84 hours/ weeks x 16 weeks = 131,04 hours	8
MMKM6013	Membrane Technology	6	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6015	Modification of Inorganic Compounds	4	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6017	Bioinorganic Applications	4	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6019	Defined Analysis Techniques	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6021	Validation of Analytical Methods	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6023	Synthesis of Organic Chemistry	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6025	Structure Elucidation of Organic Compounds	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6027	Industrial	2	5,66 hour/week x	0	2

	Enzyme Technology		16 weeks = 90,56 hours		
MMKM6004	Polymer Technology	8	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6006	Applied Materials	6	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6008	Complex Chemistry	3	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6010	Inorganic Catalyst in Chemistry	4	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6012	Advanced Chromatography	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6014	Analysis of Environmental Chemistry	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6016	Biosynthesis and Analysis of Natural Products	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6018	Isolation Techniques in Organic Chemistry	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6020	Bioassay Technology	1	5,66 hour/week x 16 weeks = 90,56 hours	0	2
MMKM6022	Fermentation and Bioprocess	2	5,66 hour/week x 16 weeks = 90,56 hours	0	2

The credit weight (SKS) of each course is calculated using the following formula:

Course Credit (Total Estimated Time) $\times$ 1 credit / (2.83 hours/week $\times$ 16 weeks) = Total Learning Hours

** If the total learning time is 90.56 hours, then: 90.56 hours / 45.28 hours = 2 credits*

*** If the total learning time is 131.04 hours, then: 131.04 hours / 45.28 hours = 2.89, which is rounded up to 3 credits*

Courses are developed by analyzing the alignment between the Intended Learning Outcomes (ILO), subject content, and Course Learning Outcomes (CLO). Based on the correlation matrix among these three components, the courses and their respective credit weights are determined. The table below illustrates the alignment between CLO and the courses.

Table 3.4 Correlation between Course Learning Outcomes (CLO) and Courses

CLO Code	CLO Description	Course Code	Course Title
CPPS01	Apply integrity and ethics in conducting scientific publications	MMKMP004	Scientific Publication
CPPS02	Able to demonstrate proficiency in conducting laboratory procedures, using basic chemical equipment, applying occupational health and safety standards, and managing chemical materials, equipment, and laboratory facilities.	MMKM1011	Laboratory Management
CPPS03	Able to critically review several recent reputable journal articles and present them in a scientific forum	MMKM1004	Capita Selecta
		MMKM1006	Colloquium of Analytical Methods
CPPS04	Able to disseminate analytical chemistry methods from recent reputable international journals in a seminar setting.	MMKM1006	Colloquium of Analytical Methods
CPPS05	Able to disseminate research designs and findings in a scientific forum.	MMKMP003	Scientific Seminar
CPPS06	Able to produce scientific work recognized nationally or internationally.	MMKMP004	Scientific Publication
CPPS07	Able to analyze in-depth knowledge in chemistry, specialized fields, or interdisciplinary fields to develop and apply original ideas.	MMKM1004	Capita Selecta
CPPS08	Able to conduct literature reviews, design research, report and disseminate findings, and publish in nationally accredited or international journals.	MMKMP003	Scientific Seminar
CPKF01	Able to understand and determine chemical and mechanical properties of materials.	MMKM1001	Quantum Chemistry and Spectroscopy
		MMKM6006	Applied Materials
CPKF02	Able to understand and calculate energetics and kinetics of materials.	MMKM1001	Quantum Chemistry and Spectroscopy
CPKF03	Demonstrate a comprehensive understanding of the fundamental concepts of membrane technology and design membranes for various applications.	MMKM6013	Membrane Technology

CPKF04	Able to develop and utilize natural and synthetic polymers for various applications.	MMKM6004	Polymer Technology
CPKF05	Able to evaluate developments in natural and synthetic polymers based on current journal articles.	MMKM6004	Polymer Technology
CPKF06	Able to understand quantum chemistry and its applications, analyze and interpret molecular structures and spectroscopic data.	MMKM1001	Quantum Chemistry and Spectroscopy
CPKF07	Able to master key factors in chemical reactions and the synthesis of new compounds, types and properties of materials, as well as their design, engineering, and applications in research and industry.	MMKM6006	Applied Materials
CPAN01	Able to analyze structures, properties, reactions, and reactivities of inorganic compounds in relation to their modification and applications.	MMKM1003	Inorganic Chemical Reactions
		MMKM6010	Inorganic Catalyst in Chemistry
		MMKM6017	Bioinorganic Applications
CPAN02	Able to conduct isolation, purification, modification, and characterization of inorganic compounds.	MMKM1003	Inorganic Chemical Reactions
CPAN03	Able to explain synthesis and modification of inorganic compounds for various applications.	MMKM6008	Complex Chemistry
		MMKM6015	Modification of Inorganic Compounds
CPAN04	Able to explain recent research developments in inorganic chemistry and their applications.	MMKM6010	Inorganic Catalyst in Chemistry
		MMKM6017	Bioinorganic Applications
		MMKM6015	Modification of Inorganic Compounds
		MMKM6008	Complex Chemistry
CPAL01	Able to evaluate halal product development processes	MMKM1002	Chemistry in Halal Products
CPAL02	Able to understand, explain methods, mechanisms, and applications of modern chemical separation techniques.	MMKM1005	Recent Methods in Chemical Separation
		MMKM6012	Advanced Chromatography
CPAL03	Able to understand and explain modern analytical chemistry concepts,	MMKM6019	Defined Analysis Techniques

	including method development and applications.	MMKM6021	Validation of Analytical Methods
CPAL04	Able to interpret environmental quality based on analytical data.	MMKM6014	Analysis of Environmental Chemistry
CPAL05	Able to apply and develop the fundamentals of measurement and analytical parameters in experimental design.	MMKM6021	Validation of Analytical Methods
CPOR01	Able to analyze reaction mechanisms of organic molecules, including stereochemistry, thermodynamics, and kinetics.	MMKM1007	Reaction Mechanism in Organic Chemistry
		MMKM6023	Synthesis of Organic Chemistry
CPOR02	Able to perform and develop techniques for the isolation and purification of organic molecules.	MMKM6018	Isolation Techniques in Organic Chemistry
CPOR03	Able to the application of biosynthetic pathways of secondary metabolites.	MMKM6016	Biosynthesis and Analysis of Natural Products
CPOR04	Able to design the synthesis of organic compounds.	MMKM6023	Synthesis of Organic Chemistry
		MMKM1007	Reaction Mechanism in Organic Chemistry
CPOR05	Able to analyze organic structures using various instrumentation techniques, including 2D NMR, for structure elucidation.	MMKM6025	Structure Elucidation of Organic Compounds
CPOR06	Able to design bioassay methods using various bioindicators for natural product compounds.	MMKM6020	Bioassay Technology
CPBI01	Able to isolate, purify, and characterize biomolecules	MMKM6022	Fermentation and Bioprocess
CPBI02	Able to identify and engineer metabolic pathways to produce specific products.	MMKM1009	Metabolic Engineering
CPBI03	Able to apply fermentation processes to produce metabolites for various applications.	MMKM6022	Fermentation and Bioprocess
CPBI04	Able to evaluate strategies for discovering and developing new enzymes	MMKM6027	Industrial Enzyme Technology
CPMKPM2	Able to formulate research problems and develop hypotheses independently, with quality and measurability.	FPPS1001	Research Methodology
CPMKPM3	Able to prepare research proposals and explain various research methods with validity and free from plagiarism.		

CPMKPM5	Able to prepare and present research proposals independently and responsibly.		
CPMKP01	Able to conduct literature reviews, select, and design research methods to be used for their thesis.	MMPAP001	Thesis Proposal
CPMKP02	Able to disseminate their research design for thesis purposes		
CPMKP03	Able to conduct, report, and disseminate research findings in the master's thesis defense.	MMPAPA01	Thesis
CPMKP04	Able to publish thesis research outcomes in the form of scientific articles in nationally accredited journals (minimum SINTA 2), indexed proceedings (Scopus), or in accordance with the graduation requirements set by the University.		

Table 3.5 Course Alignment with Intended Learning Outcomes (ILO)

Course Code	Course Title	ILO Coverage (indicate with ✓)			
		ILO01	ILO02	ILO03	ILO04
MMKM1001	Quantum Chemistry and Spectroscopy				✓
MMKM1003	Inorganic Chemical Reactions				✓
MMKM1005	Recent Methods in Chemical Separation	✓	✓	✓	✓
MMKM1007	Reaction Mechanism in Organic Chemistry				✓
MMKM1009	Metabolic Engineering				✓
FPPS1001	Research Methodology			✓	
MMKM1011	Laboratory Management				✓
MMKM1002	Chemistry in Halal Products	✓	✓		✓
MMKM1004	Capita Selecta			✓	✓
MMKM1006	Colloquium of Analytical Methods			✓	✓
MMPAP001	Thesis Proposal			✓	✓
MMKMP003	Scientific Seminar			✓	✓
MMKMP004	Scientific Publication	✓		✓	
MMPAPA01	Thesis		✓		✓
MMKM6013	Membrane Technology			✓	✓

MMKM6015	Modification of Inorganic Compounds				√
MMKM6017	Bioinorganic Applications				√
MMKM6019	Defined Analysis Techniques	√	√	√	√
MMKM6021	Validation of Analytical Methods	√		√	√
MMKM6023	Synthesis of Organic Chemistry		√		√
MMKM6025	Structure Elucidation of Organic Compounds			√	√
MMKM6027	Industrial Enzyme Technology				√
MMKM6004	Polymer Technology			√	
MMKM6006	Applied Materials			√	
MMKM6008	Complex Chemistry				√
MMKM6010	Inorganic Catalyst in Chemistry				√
MMKM6012	Advanced Chromatography				√
MMKM6014	Analysis of Environmental Chemistry				√
MMKM6016	Biosynthesis and Analysis of Natural Products				√
MMKM6018	Isolation Techniques in Organic Chemistry			√	
MMKM6020	Bioassay Technology				√
MMKM6022	Fermentation and Bioprocess				√

Table 3.6. Course Descriptions

Code	Course Title	Course Description
MMKM1001	Quantum Chemistry and Spectroscopy	This course covers chemical and mechanical properties of materials, energetics, material kinetics, atomic interactions, classical and quantum mechanics principles, basic quantum systems, spectral transitions and techniques (rotational, microwave, infrared, excited-state spectroscopy, and NMR).
MMKM1003	Inorganic Chemical Reactions	This course examines the structure and reactivity of inorganic compounds, including redox, substitution, photochemical reactions, and biologically relevant inorganic processes, with emphasis on synthesis and engineering applications.
MMKM1005	Recent Methods in Chemical Separation	This course explores modern separation techniques such as solid-phase microextraction (SPME), supercritical fluid extraction (SFE), microwave-assisted extraction, membrane separation, field flow fractionation, affinity chromatography, gel permeation chromatography, capillary electrophoresis, and hyphenated methods.
MMKM1007	Reaction Mechanism in Organic Chemistry	This course focuses on organic reaction pathways, including nucleophilic (SN1, SN2, SNi) and electrophilic aromatic substitutions, additions, oxidations, eliminations (E1, E2), and functional group interconversions.

MMKM1009	Metabolic Engineering	This course introduces metabolic pathway modifications to enhance the production of chemicals, biofuels, and pharmaceuticals through enzyme regulation and gene expression strategies.
FPPS1001	Research Methodology	This course covers research design, thesis and proposal writing formats, literature review methods, scientific writing and publication standards, and research data analysis. The main output is a draft thesis proposal.
MMKM1011	Laboratory Management	This course teaches ISO-based lab design, equipment testing and calibration, and ISO-17025 accreditation procedures.
MMKM1002	Chemistry in Halal Products	This course discuss how to examine halal-certified product development from raw material control to certification, including industrial strategies, global halal markets, lifestyle considerations, halal assurance systems, and auditing. Students learn to evaluate product halal status for food, beverages, cosmetics, pharmaceuticals, fermentation, and biotech products.
MMKM1004	Capita Selecta	This course guides students in critically analyzing recent scientific journal articles (published within the last five years) related to their thesis research. Students summarize their findings in the form of a scientific paper and present them in a seminar setting.
MMKM1006	Colloquium of Methods	This course introduces students to various analytical chemistry techniques through a comprehensive review of scientific literature and instrument manuals. Topics include fundamental principles, instrumental operations, characterization methods, and performance evaluation.
MMPAP001	Thesis Proposal	This course provides students with the opportunity to develop and present a research proposal aligned with their thesis topic. Students learn to design a research plan, formulate scientific questions, and structure proposals in accordance with the FMIPA-USK thesis guidelines. The proposal is evaluated through faculty and peer assessments to enhance academic writing and presentation skills.
MMKMP003	Scientific Seminar	This course is designed to provide students with insight, understanding, and practical experience in participating in academic forums. Students are expected to systematically present and discuss their research findings in seminar sessions held at international, national, or local levels, either in offline or online formats.
MMKMP004	Scientific Publication	This course guides students in preparing manuscripts based on thesis research for submission to at least SINTA-2 accredited national journals, international journals, or indexed proceedings.
MMPAPA01	Thesis	This course involves students to integrates cognitive, affective, and psychomotor skills in writing a comprehensive research report and presenting results in peer or field-specific seminars and a final defense.
MMKM6013	Membrane Technology	This course provides students with an understanding of (1) the definition, uses, and functions of membranes, (2) types of membranes, (3) membrane properties, (4) membrane applications, and (5) the working principles of membranes.

MMKM6015	Modification of Inorganic Compounds	This course covers the synthesis, modification, characterization, and applications of inorganic compounds. Emphasis is placed on recent advancements based on current scientific journals.
MMKM6017	Bioinorganic Applications	This course Explores the roles of metals and their compounds in biological systems. Topics include metalloporphyrins, metalloenzymes, and inorganic compounds as therapeutic agents (e.g., anticancer and antimicrobial drugs), along with their mechanisms of action. Discussions are supported by recent journal literature.
MMKM6019	Defined Analysis Techniques	This course introduces concepts of chemical analysis and their practical applications, with a focus on advanced analytical techniques including sample preparation and preconcentration, flow injection analysis (FIA), thermal analysis (TGA, DTA, DSC), SEM analysis, elemental analysis (TN, TOC, total sulfur, mercury), non-aqueous titration, Raman and near-infrared (NIR) spectroscopy, chemical sensors and biosensors, atomic force microscopy (AFM), method validation, and instrument performance evaluation.
MMKM6021	Validation of Analytical Methods	This course discusses fundamental principles of measurement, error theory, regression analysis, and the use of chemical analysis parameters in experimental design. Topics include detection limits, sensitivity, selectivity, reproducibility, and validity, along with data processing techniques.
MMKM6023	Synthesis of Organic Chemistry	This course covers the reactions and steps involved in organic compound synthesis, including retrosynthetic analysis and alternative synthetic methods. Topics include the synthesis of simple organic molecules, vitamins, arachidonic acid analogs, and total synthesis of complex molecules such as periplanone derivatives, antibiotics, Taxol, and steroid derivatives.
MMKM6025	Structure Elucidation of Organic Compounds	This course focuses on elucidating the structures of complex organic molecules using spectroscopic and spectrometric techniques, including 1D-NMR (DEPT, NOE-diff), 2D-NMR (COSY, NOESY, HMQC, HMBC, HSQC), and high-resolution mass spectrometry (HRMS). Students will analyze recent journal articles related to structure elucidation.
MMKM6027	Industrial Enzyme Technology	This course introduces strategies for discovering and developing novel enzymes for industrial applications. It includes content on enzyme isolation, purification, and characterization.
MMKM6004	Polymer Technology	This course presents fundamental concepts of polymerization processes and their applications in polymer technology. Topics include free-radical vinyl polymerization, and reactions involving vinyl polymers, polyethers, polysulfides, polyesters, polyamides, phenolic polymers, urea-formaldehyde and melamine-formaldehyde resins, inorganic and hybrid polymers, specialty organic polymers, and natural polymers.
MMKM6006	Applied Materials	This course covers crystalline materials, biomaterials, porous materials, composites, and nanomaterials. Topics include material characterization (XRD, SEM, TGA, DSC, FTIR, PSA), material design and engineering, as well as current research

		trends in materials science.
MMKM6008	Complex Chemistry	This course examines the synthesis, characterization, and applications of coordination compounds and their recent developments based on current scientific publications.
MMKM6010	Inorganic Catalyst in Chemistry	This course discusses the types, synthesis, modification, characterization, and performance testing of inorganic catalysts, along with their applications. Students will also review the latest research on catalyst synthesis and application as reported in recent journals.
MMKM6012	Advanced Chromatography	This course covers retention parameters and indices, separation efficiency, column design, chromatogram broadening theory, Van Deemter model, validation methods in chromatography, and advanced separation techniques such as affinity, hydrophobic, gel permeation chromatography (SEC), supercritical fluid chromatography (SFC), and hyphenated techniques.
MMKM6014	Analysis of Environmental Chemistry	This course enhances students' understanding of the importance of environmental quality and the analytical methods used to assess environmental parameters. Students will develop skills to evaluate and interpret environmental data.
MMKM6016	Biosynthesis and Analysis of Natural Products	This course covers biosynthesis and analysis of natural product sources such as terpenoids, steroids, flavonoids, alkaloids, and polyketides. Topics also include pharmacological effects, biogenesis, and the enzymes involved in the biosynthetic pathways of these natural products.
MMKM6018	Isolation Techniques in Organic Compound	This course examines journal literature related to the isolation of secondary metabolites using various extraction and purification techniques.
MMKM6020	Bioassay Technology	This course Explores the bioactivity of secondary metabolites, including pesticidal and herbicidal activities, toxicity, antimicrobial, antioxidant, antitumor, antimalarial, anticancer, and antiviral properties.
MMKM6022	Fermentation and Bioprocess	This course introduces the principles of fermentation and bioprocessing for product development. Students will learn how selected microorganisms can be used to produce target compounds more economically. Topics include isolation and purification of fermentation products.

3.6 Curriculum Structure

Table 3.7. List of courses

No	Course Code	Course Title	Credits (SKS)	(T-P)	Category	Prerequisites
SEMESTER 1						
1.	MMKM1001	Quantum Chemistry and Spectroscopy	2	(2-0)	W	-
2	MMKM1003	Inorganic Chemical Reactions	2	(2-0)	W	-
3	MMKM1005	Recent Methods in Chemical Separation	2	(2-0)	W	-
4	MMKM1007	Reaction Mechanism in Organic Chemistry	2	(2-0)	W	-
5	MMKM1009	Metabolic Engineering	2	(2-0)	W	-
6	FPPS1001	Research Methodology	2	(2-0)	W	-
7	MMKM1011	Laboratory Management	2	(2-0)	W	-
	Total		14			
SEMESTER 2						
1	MMKM1002	Chemistry in Halal Products	2	(2-0)	W	-
2	MMKM1004	Capita Selecta	3	(0-3)	W	-
3	MMKM1006	Colloquium of Analytical Methods	2	(0-2)	W	-
4	MMPAP001	Thesis Proposal	2	(0-2)	W	-
5		Elective courses	8		P	-
	Total		17			
SEMESTER 3						
1	MMKMP003	Scientific Seminar	2	(0-2)	W	-
2		Elective courses	10		P	-
	Total		12			
SEMESTER 4						
1	MMKMP004	Scientific Publication	3	(0-3)	W	-
2	MMPAPA01	Thesis	8	(0-8)	W	-
	Total		11			

ELECTIVE COURSES OFFERED IN SEMESTER 3 (FIRST TERM)						
No	Course Code	Course Title	Credit (SKS)	(T-L)	Category	Prerequisites
1	MMKM6013	Membrane Technology	2	(2-0)	P	-
2	MMKM6015	Modification of Inorganic Compounds	2	(2-0)	P	-
3	MMKM6017	Bioinorganic Applications	2	(2-0)	P	-
4	MMKM6019	Defined Analysis Techniques	2	(2-0)	P	-
5	MMKM6021	Validation of Analytical Methods	2	(2-0)	P	-
6	MMKM6023	Synthesis of Organic Chemistry	2	(2-0)	P	-
7	MMKM6025	Structure Elucidation of Organic Compounds	2	(2-0)	P	-
8	MMKM6027	Industrial Enzyme Technology	2	(2-0)	P	-
	Total		16			

ELECTIVE COURSES OFFERED IN SEMESTER 2 & 4 (SECOND TERM)						
No	Course Code	Course Title	Credit (SKS)	(T-L)	Category	Prerequisites
1	MMKM6004	Polymer Technology	2	(2-0)	P	-
2	MMKM6006	Applied Materials	2	(2-0)	P	-
3	MMKM6008	Complex Chemistry	2	(2-0)	P	-
4	MMKM6010	Inorganic Catalyst in Chemistry	2	(2-0)	P	-
5	MMKM6012	Advanced Chromatography	2	(2-0)	P	-
6	MMKM6014	Analysis of Environmental Chemistry	2	(2-0)	P	-
7	MMKM6016	Biosynthesis and Analysis of Natural Products	2	(2-0)	P	-
8	MMKM6018	Isolation Techniques in Organic Chemistry	2	(2-0)	P	-
9	MMKM6020	Bioassay Technology	2	(2-0)	P	-
10	MMKM6022	Fermentation and Bioprocess	2	(2-0)	P	-
Total			20			

3.7 Curriculum Summary

A summary of the curriculum for the Master in Chemistry Program , including course categories and total credit hours, is presented in Table 3.8.

Table 3.8 General Curriculum Information

General Information	Credit (SKS)
Minimum total credit hours required for graduation	54
Minimum required elective credits	18
Total elective courses offered	36
Number of general (MKWU) courses	-
Number of courses focused on practical/professional skills	18
Number of courses in fundamental scientific knowledge	-
Number of courses in specialized/professional competencies	74
Number of curricular/extracurricular activities supporting innovation, entrepreneurship, and digital competencies	-
Number of courses aligned with the SDGs vision	54

Table 3.9. Characteristics of Elective Courses

No	Course Code	Course Title	Credit (SKS)	Characteristics (√)								
				A	B	C	D	E	F	G	T	P
1	MMKM6013	Membrane Technology	2	√	√		√	√				
2	MMKM6015	Modification of Inorganic Compounds	2	√				√				
3	MMKM6017	Bioinorganic Applications	2	√				√				
4	MMKM6019	Defined Analysis Techniques	2	√	√		√	√				
5	MMKM6021	Validation of Analytical Methods	2	√	√	√	√	√				
6	MMKM6023	Synthesis of Organic Chemistry	2	√								
7	MMKM6025	Structure Elucidation of Organic Compounds	2	√								
8	MMKM6027	Industrial Enzyme Technology	2	√			√	√				
9	MMKM6004	Polymer Technology	2	√	√		√	√				
10	MMKM6006	Applied Materials	2	√	√		√	√				
11	MMKM6008	Complex Chemistry	2	√				√				
12	MMKM6010	Inorganic Catalyst in Chemistry	2	√				√				
13	MMKM6012	Advanced Chromatography	2	√	√	√	√	√				
14	MMKM6014	Analysis of Environmental Chemistry	2	√	√		√	√				
15	MMKM6016	Biosynthesis and Analysis of Natural Products	2	√								
16	MMKM6018	Isolation Techniques in Organic Chemistry	2	√	√							
17	MMKM6020	Bioassay Technology	2	√	√							
18	MMKM6022	Fermentation and Bioprocess	2	√			√	√				

Legend:**A** = Deepening of core scientific disciplines**B** = Enhancement of skills/professional development in the workplace**C** = Development of IT-related skills**D** = Encouragement of entrepreneurship**E** = Enhancement of soft skills**F** = Eligible for equivalence with MBKM activities (*Merdeka Belajar Kampus Merdeka*)**G** = Others**T** = Tutorial**P** = Practical/Laboratory component

Table 3.10 List of Courses Related to the Implementation of SDGs, Research-Based Learning (RBL), Project-Based Learning (PjBL), Case Method (Case-M), and/or the Independent Learning-Independent Campus (MBKM) Program

No	Course Code	Course Title	Credit (SKS)	Category	SDG Alignment	Learning Characteristics			
						PBR	PjBL	Case-M	MBKM
1	MMKM1001	Quantum Chemistry and Spectroscopy	2	W	4				
2	MMKM1003	Inorganic Chemical Reactions	2	W	4, 9				
3	MMKM1005	Recent Methods in Chemical Separation	2	W	4				
4	MMKM1007	Reaction Mechanism in Organic Chemistry	2	W	0				
5	MMKM1009	Metabolic Engineering	2	W	9				
6	FPPS1001	Research Methodology	2	W	4				
7	MMKM1011	Laboratory Management	2	W	3			√	
8	MMKM1002	Chemistry in Halal Products	2	W	12			√	
9	MMKM1004	Capita Selecta	3	W	4		√		
10	MMKM1006	Colloquium of Analytical Methods	2	W	4		√		
11	MMPAP001	Thesis Proposal	2	W	0		√		
12	MMKMP003	Scientific Seminar	2	W	0		√		
13	MMKMP004	Scientific Publication	3		0		√		
14	MMPAPA01	Thesis	8	W	9, 12		√		
15	MMKM6013	Membrane Technology	2	P	9				
16	MMKM6015	Modification of Inorganic Compounds	2	P	9				
17	MMKM6017	Bioinorganic Applications	2	P	3, 9				
18	MMKM6019	Defined Analysis Techniques	2	P	4				
19	MMKM6021	Validation of Analytical Methods	2	P	4			√	
20	MMKM6023	Synthesis of Organic Chemistry	2	P	9				
21	MMKM6025	Structure Elucidation of Organic	2	P	0				

		Compounds <i>Structure</i>							
22	MMKM6027	Industrial Enzyme Technology	2	P	9			√	
23	MMKM6004	Polymer Technology	2	P	9				
24	MMKM6006	Applied Materials	2	P	9				
25	MMKM6008	Complex Chemistry	2	P	9				
26	MMKM6010	Inorganic Catalyst in Chemistry	2	P	6, 7, 13				
27	MMKM6012	Advanced Chromatograph y	2	P	3, 4, 9				
28	MMKM6014	Analysis of Environmental Chemistry	2	P	4				
29	MMKM6016	Biosynthesis and Analysis of Natural Products	2	P	3, 6				
30	MMKM6018	Isolation Techniques in Organic Chemistry	2	P	3			√	
31	MMKM6020	Bioassay Technology	2	P	3				
32	MMKM6022	Fermentation and Bioprocess	2	P	9		√		

SDGs = Sustainable Development Goals (SDGs). The Sustainable Development Goals (SDGs) represent a universal agenda agreed upon by the global community to achieve sustainable development by 2030, grounded in human rights and the principles of equality. The SDGs comprise 17 goals and 169 specific targets:

(1) No poverty; (2) Zero hunger; (3) Good health and well-being; (4) Quality education; (5) Gender equality; (6) Clean water and sanitation; (7) Affordable and clean energy; (8) Decent work and economic growth; (9) Industry, innovation, and infrastructure; (10) Reduced inequalities; (11) Sustainable cities and communities; (12) Responsible consumption and production; (13) Climate action; (14) Life below water; (15) Life on land; (16) Peace, justice, and strong institutions; and (17) Partnerships for the goals (Bappenas, 2017).v

PBR = Research-Based Learning

PjBL = Project-Based Learning

Case-M = Case Method

MBKM = Independent Learnin- Independent Campus (Merdeka Belajar–Kampus Merdeka)

3.8 Equivalency and Credit Recognition for MBKM Activities

3.8.1 List of Course Equivalencies

Previous Courses				Revised Courses			
No	Course Code	Course Title	Credits (SKS)	No	Course Code	Course Title	Credits (SKS)
1	MKM605	Advanced Physical Chemistry	2	1	MMKM1001	Quantum Chemistry and Spectroscopy	2
					MMKM6013	Membrane Technology	2
2	MKM635	Inorganic Chemical Reactions	2	2	MMKM1003	Inorganic Chemical Reactions	2
					MMKM6015	Modification of Inorganic Compounds	2
3	MKM633	Advanced Separation Methods	2	3	MMKM1005	Recent Methods in Chemical Separation	2
					MMKM1002	Chemistry in Halal Products	2
4	MKM629	Reaction Mechanism in Organic Chemistry	2	4	MMKM1007	Reaction Mechanism in Organic Chemistry	2
					MMKM6020	Bioassay Technology	2
5	MKM631	Metabolic Engineering	2	5	MMKM1009	Metabolic Engineering	2
					MMKM6027	Industrial Enzyme Technology	2
6	PPS601	Research Methodology	2	6	FPPS1001	Research Methodology	2
7	PPS603	Statistics	2	7	MMKM6018	Isolation Techniques in Organic Chemistry	2
8	MKM616	Laboratory Management	2	8	MMKM1011	Laboratory Management	2
					MMKM6014	Analysis of Environmental Chemistry	2
9	MKM656	Chemistry in Halal Products	2	9	MMKM1002	Chemistry in Halal Products	2
10	MKMP02	Capita Selecta	2	10	MMKM1004	Capita Selecta	3

11	MKMP05	Colloquium of Analytical Methods	2
12	MKMP07	Thesis Proposal	2
13	MPAPT1	Thesis	6
14	MKM739	Membrane Technology	2
15	MKM723	Modification of Inorganic Compounds	2
16	MKM737	Bioinorganic Applications	2
17	MKM725	Advanced Analytical Techniques	2
18	MKM735	Analytical Method Validation	2
19	MKM707	Synthesis of Organic Chemistry Lanjut	2
20	MKM729	Structure Elucidation of Organic Compounds	2
21	MKM733	Industrial Enzyme Technology	2
22	MKM658	Polymer Technology	2
23	MKM660	Applied Materials	2
24	MKM636	Complex Chemistry	2
25	MKM638	Inorganic Catalyst in Chemistry	2
26	MKM618	Advanced Chromatography	2
27	MKM648	Analysis of Environmental	2

11	MMKM1006 MMKM6008	Colloquium of Analytical Methods Complex Chemistry	2 2
12	MMPAP001 MMKMP003 MMKMP004	Thesis Proposal Scientific Seminar Scientific Publication	2 2 3
13	MMPAPA01	Thesis	8
14	MMKM6013	Membrane Technology	2
15	MMKM6015	Modification of Inorganic Compounds	2
16	MMKM6017	Bioinorganic Applications	2
17	MMKM6019	Defined Analysis Techniques	2
18	MMKM6021	Validation of Analytical Methods	2
19	MMKM6023	Synthesis of Organic Chemistry	2
20	MMKM6025	Structure Elucidation of Organic Compounds	2
21	MMKM6027	Industrial Enzyme Technology	2
22	MMKM6004	Polymer Technology	2
23	MMKM6006	Applied Materials	2
24	MMKM6008	Complex Chemistry	2
25	MMKM6010	Inorganic Catalyst in Chemistry	2
26	MMKM6012	Advanced Chromatography	2
27	MMKM6014	Analysis of Environmental	2

		Chemistry	
28	MKM652	Biosynthesis and Analysis of Natural Products	2
29	MKM654	Biological Research Techniques	2
30	MKM662	Fermentation and Bioprocess	2

		Chemistry	
28	MMKM6016	Biosynthesis and Analysis of Natural Products	2
29	MMKM6020	Bioassay Technology	2
30	MMKM6022	Fermentation and Bioprocess	2

3.8.2 List of Recognized Courses

The Master in Chemistry Program does not implement the MBKM (Independent Learning - Independent Campus) program.

3.9 Examples of Course Design Using the Case Method and Team-Based Projects

Example of a Semester Learning Plan (RPS) for a the Case Method-Based Course

SEMESTER LEARNING PLAN (RPS) LABORATORY MANAGEMENT

		UNIVERSITAS SYIAH KUALA FMIPA MASTER IN CHEMISTRY STUDY PROGRAM				Document Code : 47101-007-02-03		
Courses	Course Code	Category	Prerequisite	Course Cluster	Credits (SKS)		Semester	Date of Compilation
Laboratory Management	MMKM1011	Compulsory	-	Chemistry	T= 2	P= 0	1	August 1, 2024
Authorization		Syllabus Development Coordinator		Course Coordinator		Study Program Coordinator		
		 Prof. Dr. TM Iqbalsyah, M.Sc		 Dr. Surya Lubis, M.Si		 Dr. Surya Lubis M.Si		
Course Instructor		1. Dr. Surya Lubis, M.Si 2. Prof. Dr. TM Iqbalsyah, M.Sc						
Brief Description of MK		This course covers ISO-standard laboratory design, testing and calibration methods, and the procedures for applying for ISO-17025 accreditation.						
Learning Outcomes		Graduate Learning Outcomes assigned to the course						
		ILO04	Possess comprehensive knowledge of chemistry, encompassing both specialized and interdisciplinary domains, to promote the development and application of original ideas.					
		Course Learning Outcomes						
Correlation Matrix of ILO and CLO		CPPS02	Apply principles of laboratory safety and management in handling instruments and chemicals, and in designing standardized laboratory systems.					
		Correlation of ILO to CLO						
		CLO	ILO (%)	CLO Weight				
		ILO04	100%	100%				
CLO Compliance Matrix to University Vision, SDGs, and Research Based Learning (RBE)		CPPS02	100%	100%				
		ILO Weight (%)	100%	100%				
		Correlation of CLO to University Vision, SDGs, and RBL						
		Aspect	CLO					
Study Materials / Learning materials		CPPS02						
		Socio-Technopreneur		-				
		SDGs th-		3				
		Research-Based Learning		-				
Recommended Literature		1. The concept of Anticipation, Recognition, Evaluation and Control (AREC) and hazard control						
		2. Identification of chemical hazards						
		3. Emergency procedures and fire handling						
		4. Job hazards analysis						
Recommended Literature		5. Chemical safety vs security, Dual use chemicals						
		6. Purchase of chemicals						
		7. Basic concepts of designing a chemical laboratory						
		8. Storage of chemical materials and equipment						
Recommended Literature		9. ISO 17025 : 2017 laboratory certification						
		10. Calibration and validation of laboratory equipment						
		Main:						
		1. NIOSH, 2006, School Chemistry Laboratory Safety Guide http://www.cpsc.gov/Andhttp://www.ehs.berkeley.edu/chemical-safety						
Recommended Literature		2. Dahan, FW 2000, Laboratories: A Guide to Master Planning, Programming Procurement and Design, WW Norton & Co., NY.						
		3. http://www.ehs.berkeley.edu/chemical-safety						
		Supporting: Journals, other textbooks and organic chemistry e-books related to the topic of discussion						

Assessment criteria	Assessment Criteria and Items					
	Score Range	Quality Letter		Category	Graduation Status	
	≥87	A		Excellent	Pass	
	78 - <87	AB		Distinction		
	69 - <78	B		Good		
	60 - <69	BC		Fairly good		
	51 - <60	C		Fair		
	41 - <51	D		Poor	Fail	
<41	E		Fail			
Evaluation Plan	Learning Methods/Models :	Case method/Team-based project	√	Non Case method/Team-based project	-	
	Evaluation Basis	Evaluation Components	Weight Distribution /CLO (%)		Total Weight Case Method/Team-Based Project	Total Weight Non Case Method/Team-Based Project
			CPPS02			
			100%			
	Participatory Activities	Case Method	30	30		
	Project Results	Team-Based Project	70	70		
	Cognitive and affective	Task	0			
	Cognitive/ Knowledge	Mid-Semester Exam (UTS)	0			
	Cognitive/ Knowledge	Final Semester Exam (UAS)	0			
	Total Weight/ CLO		100			
Conclusion of Types of Learning Methods		Case Method/Team-Based Project	100			

SCHEDULE, MATERIAL DESCRIPTION AND LECTURE ACTIVITIES

Week 2	Final Competencies of Each Student Learning Stage (Sub-CLO)	Evaluation		Learning Forms, Learning Methods, and Student Assignments (time estimates)		Learning materials	Mark (%)
		Indicator	Criteria & Techniques	Offline	Online		
1	Students are able to explain the concept of AREC and hazard control-CPPS02	Able to answer questions about AREC concept and hazard control	Assessment is carried out through a question and answer test.	Model: <u>Direct Instruction Method</u> -Class meetings and discussions Approach: <u>Inquiry and questioning Scenario</u> : The lecturer delivered material with relevant examples, students and lecturers discuss		AREC concept and hazard control	
2	Students are able to identify chemical hazards	Able to answer questions and assignments about chemical hazards	Assessment is done through assignment results	Model: <u>Task-based learning Method</u> -Class meetings, assignment discussions Approach: <u>Inquiry, questioning, constructivism Scenario</u> : The lecturer delivers the material with relevant examples		Identification of chemical hazards	
3	Students are able to explain and carry out emergency procedures and fire handling.	Able to answer questions about Q&A		Model: <u>Direct Instruction Method</u> -Class meetings and discussions Approach: <u>Inquiry and questioning Scenario</u> : The lecturer		Emergency procedures and fire handling	

Week 2	Final Competencies of Each Student Learning Stage (Sub-CLO)	Evaluation		Learning Forms, Learning Methods, and Student Assignments (time estimates)		Learning materials	Mark (%)
		Indicator	Criteria & Techniques	Offline	Online		
				delivered material with relevant examples, students and lecturers discuss			
4	Students are able to conduct job hazards analysis	Able to answer questions and complete assignments about job hazards analysis	Assessment is done through assignment results	<u>Model:</u> Task-based learning <u>Method:</u> Class meetings, assignment discussions <u>Approach:</u> Inquiry, questioning, constructivism <u>Scenario:</u> The lecturer delivers the material with relevant examples, students individually work on hazard analysis assignments in their work, and students submit written reports. Estimated Task Completion Time: 1 week		Job hazards analysis	15%
5	Students are able to explain chemical safety vs security and dual use chemicals.	Able to answer questions about or assignments about Students are able to explain chemical safety vs security and dual use chemicals.		<u>Model:</u> Direct Instruction <u>Method:</u> Class meetings and discussions <u>Approach:</u> Inquiry and questioning <u>Scenario:</u> The lecturer delivered material with relevant examples, students and lecturers discuss		Chemical safety vs security and dual use chemicals	
6-7	Students are able planning and making chemical purchases	Able to answer questions and complete assignments regarding purchasing chemicals	Assessment is done through assignments and presentations.	<u>Model:</u> Task-based learning <u>Method:</u> Class meetings, assignment discussions <u>Approach:</u> Inquiry, questioning, constructivism <u>Scenario:</u> The lecturer delivers the material with relevant examples, students individually calculate the needs and make chemical purchases, the lecturer provides assistance during the completion of the assignment, students submit written reports. Task Completion: 1 week		Purchase of chemicals	15%
8	Students are able evaluate the laboratory	Able to answer questions about basic concepts of laboratory design		<u>Model:</u> Direct Instruction <u>Method:</u> Class meetings and discussions <u>Approach:</u> Inquiry and questioning <u>Scenario:</u> The lecturer delivered material with relevant examples,		Basic concepts of laboratory design	30%

Week 2	Final Competencies of Each Student Learning Stage (Sub-CLO)	Evaluation		Learning Forms, Learning Methods, and Student Assignments (time estimates)		Learning materials	Mark (%)
		Indicator	Criteria & Techniques	Offline	Online		
				students work in groups to complete assignments on clinical laboratory evaluation and present them. Task Completion: 2 weeks			
9-10	Students are able to explain the storage of chemicals and equipment	Able to answer questions about the storage of chemicals and equipment and present the results of the evaluation of the storage of chemicals and equipment in a laboratory.	Assessment is carried out through assigned tasks and presenting the results of the evaluation of the storage of chemicals and equipment in a laboratory.	<u>Model:</u> Task-based learning <u>Method:</u> Class meetings, assignment discussions <u>Approach:</u> Inquiry, questioning, constructivism <u>Scenario:</u> The lecturer explains the material, students work in groups to complete assignments about storage procedures for chemical materials and equipment. Task Completion: 2 weeks		Storage of chemicals and tools	20%
11-13	Students are able to explain ISO 17025: 2017 laboratory certification.	Able to answer questions about basic concepts of laboratory design		<u>Model:</u> Direct Instruction <u>Method:</u> Class meetings and discussions <u>Approach:</u> Inquiry and questioning <u>Scenario:</u> The lecturer delivered material with relevant examples, students and lecturers discuss.		ISO 17025:2017 laboratory certification	
14-16	Students are able to evaluate the calibration and validation of laboratory equipment.	Able to answer and complete assignments regarding calibration and validation of laboratory equipment	Assessment is carried out through assigned tasks and presenting the results of calibration evaluation and validation of equipment in a laboratory.	<u>Model:</u> Task-based learning <u>Method:</u> Class meetings, assignment discussions <u>Approach:</u> Inquiry, questioning, constructivism <u>Scenario:</u> The lecturer explains the material, students work in groups to complete assignments on ISO certification procedures, and certification of one of the parameter testing methods according to SNI/ASTM and the calibration/validation procedures for the instruments used, students present their assignments. Task Completion: 2 weeks		Calibration and validation of laboratory equipment	20%
	Total Weight						100%

Example of Semester Learning Plan (RPS) for a Team-Based Project (Project-Based Learning) Course

SEMESTER LEARNING PLAN (RPS) REACTION MECHANISM IN ORGANIC CHEMISTRY

		UNIVERSITAS SYIAH KUALA					Document Code : 47101-004-04-00	
		FMIPA						
		MASTER IN CHEMISTRY STUDY PROGRAM						
Courses (MK)	MK Code	Category	Prerequisite	Course Cluster	Credits (SKS)		Semester	Date of Compilation
Organic Chemical Reaction Mechanism	MMKM1007	Compulsory	-	Biological Chemistry	T= 2	P= 0	1	August 13, 2025
Authorization		Syllabus Development Coordinator		Course Coordinator		Study Program Coordinator		
		 Muhammad Bahi, Ph.D.		 Muhammad Bahi, Ph.D.		 Dr. Surya Lubis M.Si		
Supporting lecturer		Organic Chemistry Teaching Team						
Course Description		This course discusses reaction mechanisms in organic chemistry which include nucleophilic substitution reactions (SN1, SN2 and SNi), electrophilic substitution reactions in aromatic compounds and their derivatives, other reactions such as addition, oxidation, elimination (E1 and E2), and functional group interconversion reactions.						
Learning Outcomes		Graduate Learning Outcomes assigned to the course						
		ILO04	Possess comprehensive knowledge of chemistry, encompassing both specialized and interdisciplinary domains, to promote the development and application of original ideas.					
		Course Learning Outcomes						
		CPOR01	Analyze the mechanisms of organic molecular reactions, including aspects of stereochemistry, thermodynamics, and kinetics of a reaction.					
		CPOR04	Design the synthesis of organic compounds.					
Correlation Matrix of ILO and CLO		Correlation of ILO to CLO						
		CLO		ILO (%)		CLO Weight (%)		
		CPOR01		ILO04		75		
		CPOR04		ILO04		25		
		ILO Weight (%)		100		100		
CLO Compliance Matrix to University Vision, SDGs, and Research Based Learning (RBE)		Correlation of CLO to University Vision, SDGs, and RBL						
		Aspect		CLO				
				CPOR01		CPOR04		
		Socio-Technopreneur		-		-		
		SDGs th-		-		-		
Study Materials / Learning materials		Research-Based Learning		-		-		
		1. Mechanism of nucleophilic substitution reactions (SN1, SN2 and SNi)						
		2. The mechanism of electrophilic substitution reactions in aromatic compounds and their derivatives						
		3. Addition reaction mechanism						
		4. Oxidation reaction mechanism						
		5. Elimination reaction mechanisms (E1 and E2)						
		6. Mechanism of condensation reactions and carbonyl compounds						
		7. Pericyclic and cycloaddition reaction mechanisms						
		8. Free radical reaction mechanism						
		9. Photochemical reaction mechanism						
Recommended Literature		10. Functional group interconversion reaction mechanism						
		Main:						
		1. Fesenden, RJ and Fesenden, JS (Translated by AH Pudjaatmaka) (1989) Organic Chemistry, volumes 1 and 2, Erlangga.						
		2. McMurry, J., (2005), "Organic Chemistry," Brooks/Cole Publishing Company, Pacific Grove, California, 5th edition.						
		3. RS Monson, 2002, Advanced Organic Synthesis, Methods and Techniques, Academic						

Evaluation	Press, New York 4. Carey, FA and Sundberg, RJ, 2007. Advanced Organic Chemistry. Springer, New York, 5th edition				
	Supporters:				
	Several e-books and e-journals related to the reaction mechanisms of organic compounds				
	Assessment Criteria and Items:				
Evaluation	Score Range	Quality Letter	Category	Graduation Status	
	≥87	A	Excellent	Pass	
	78 - <87	AB	Distinction		
	69 - <78	B	Good		
	60 - <69	BC	Fairly good		
	51 - <60	C	Fair		
	41 - <51	D	Poor	Fail	
	<41	E	Fail		
Evaluation Plan	Learning methods	Case Method/Team-Based Project		Non Case Method/Team-Based Project	√
	Evaluation Basis	Evaluation Components	Weight Distribution /CLO (%)		Total Weight Case Method/Team-Based Project
			CPOR01	CPOR04	
			75	25	
	Participatory Activities	Case Method	0	0	0
	Project Results	Team-Based Project	0	0	0
	Cognitive and affective	Task	20	20	20
	Cognitive	Quiz	20	20	20
	Cognitive	Mid-term exam	30	30	30
	Cognitive	Final Exam	30	30	30
	Total CLO Weight		100	100	
	Conclusion of Types of Learning Methods		Non Case Method/Team-Based Project		0
					100

SCHEDULE, MATERIAL DESCRIPTION AND LECTURE ACTIVITIES

Week 2	Final Competency of Student Learning Stages (Sub-CLO)	Evaluation		Learning Forms, Learning Methods, and Student Assignments (time estimates)		Learning materials	Mark (%)
		Indicator	Criteria and Techniques	Offline	On line		
1 and 2	Students are able to explain nucleophilic substitution reaction mechanisms (SN1, SN2 and SNi)	Students can explain correctly nucleophilic substitution reaction mechanisms (SN1, SN2 and SNi)	Assessment is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about nucleophilic substitution reaction mechanisms (SN1,		Mechanism of nucleophilic substitution reactions • SN1 • SN2 • SNi	13% (cognitive: 10%, Affective 3%)

Week 2	Final Competency of Student Learning Stages (Sub-CLO)	Evaluation		Learning Forms, Learning Methods, and Student Assignments (time estimates)		Learning materials	Mark (%)
		Indicator	Criteria and Techniques	Offline	On line		
3 and 4	Students are able to explain electrophilic substitution reaction mechanisms in aromatic compounds and their derivatives	Students can explain correctly electrophilic substitution reaction mechanisms in aromatic compounds and their derivatives	Assessment is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about electrophilic substitution reaction mechanisms in aromatic compounds and their derivatives		The mechanism of electrophilic substitution reactions in aromatic compounds and their derivatives	13% (cognitive: 10%, Affective: 3%)
5			Quiz = 20%	Assignment = 6%			26%
6	Students are able to explain addition reaction mechanism	Students can explain correctly addition reaction mechanism	Assessment is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about addition reaction mechanism		Addition reaction mechanism • Mechanism of addition reactions of alkenes and alkynes	8% (cognitive: 6%, affective: 2%)
7	Students are able to explain oxidation reaction mechanism	Students can explain correctly oxidation reaction mechanism	Assessment is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about oxidation reaction mechanism		Oxidation reaction mechanism	8% (cognitive: 6%, affective: 2%)
8	Students are able to explain condensation reaction mechanisms and carbonyl compounds	Students can explain correctly condensation reaction mechanisms and carbonyl	Assessment is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture &		Mechanism of condensation reactions and carbonyl compounds	8% (cognitive: 6%, affective: 2%)

Week 2	Final Competency of Student Learning Stages (Sub-CLO)	Evaluation		Learning Forms, Learning Methods, and Student Assignments (time estimates)		Learning materials	Mark (%)
		Indicator	Criteria and Techniques	Offline	On line		
		compounds		discussion. Assignment: Students individually complete assignments aboutmcondensati on reaction mechanisms and carbonyl compounds			
9 and 10	Students are able to explain elimination reaction mechanisms (E1 and E2)	Students can explain correctly elimination reaction mechanisms (E1 and E2)	Assessm ent is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about elimination reaction mechanisms (E1 and E2)		Elimination reaction mechanism • E1 • E2	14% (cogniti ve: 11%, affectiv e: 3%)
11	Mid-term exam = 30% Assignments = 8%						38%
12	Students are able to explain pericyclic and cyclo addition reaction mechanisms	Students can explain correctly pericyclic and cyclo addition reaction mechanisms	Assessm ent is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about pericyclic and cycloaddition reaction mechanisms		Pericyclic and cycloaddition reaction mechanisms	8% (cogniti ve: 6%, affectiv e: 2%)
13	Students are able to explain free radical reaction mechanism	Students can explain correctly free radical reaction mechanism	Assessm ent is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments aboutmfree radical reaction		Free radical reaction mechanism	8% (cogniti ve: 6%, affectiv e: 2%)

Week 2	Final Competency of Student Learning Stages (Sub-CLO)	Evaluation		Learning Forms, Learning Methods, and Student Assignments (time estimates)		Learning materials	Mark (%)
		Indicator	Criteria and Techniques	Offline	On line		
				mechanism			
14	Students are able to explain photochemical reaction mechanism	Students can explain correctly photochemical reaction mechanism	Assessment is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about photochemical reaction mechanism		Photochemical reaction mechanism	8% (cognitive: 6%, affective: 2%)
15	Students are able to explain functional group interconversion reaction mechanism	Students can explain correctly functional group interconversion reaction mechanism	Assessment is done through an essay test	Model: Problem based instruction (PBI) and Direct Instruction (DI) Approach: Process skills Method: Lecture & discussion. Assignment: Students individually complete assignments about functional group interconversion reaction mechanism		Functional group interconversion reaction mechanism	11% (cognitive: 9%, affective: 2%)
16	Final Exam = 30%; Assignments 6%						36%
TOTAL WEIGHT							100%

3.10 Example of Course Contract/ Course Agreement for the Study Program



UNIVERSITAS SYIAH KUALA
Darussalam, Banda Aceh

DOCUMENT: COURSE AGREEMENT			
Code	: 004/UN.11.2 /MKIM/KK/2024	Date of issue	: August 13 2025
Area	: Master in Chemistry Faculty of Mathematics and Natural Sciences, USK	Revision No.	:

Course Name	: Reaction Mechanism in Organic Chemistry
Course Code	: MMKM1007
Credit Weight	: 2
Semester	: 1
Course Status	: Compulsory
Class	: A
Meeting Day	: Saturday 14.00-15.40
Meeting Place	: Room A.01.02
MK Coordinator	: Muhammad Bahi, Ph. D
MK Advisory Team	: 1. Muhammad Bahi, Ph.D 2. Prof. Dr. Binawati Ginting, M.Si

1. Course Outcomes

- Students are able to analyze the physical properties and mechanisms of organic reactions.
- Applying reaction mechanisms to other relevant subjects
- Building critical and logical thinking skills

2. Course Description

The Organic Chemical Reaction Mechanism course discusses reaction mechanisms in organic chemistry which include nucleophilic substitution reactions (SN1, SN2 and SNi), electrophilic substitution reactions in aromatic compounds and their derivatives, other reactions such as addition, oxidation, elimination (E1 and E2), and functional group interconversion reactions.

3. Intended Learning Outcomes (ILO)

ILO04 : Possess comprehensive knowledge of chemistry, encompassing both specialized and interdisciplinary domains, to promote the development and application of original ideas.

4. Learning strategies

Model: Problem based instruction (PBI) and Direct Instruction (DI)
Approach: Process skills
Method: Lecture & discussion and assignment giving.

5. Subject matter

- Substitution reaction mechanism nucleophilic (SN1, SN2 and SNi)
- The mechanism of electrophilic substitution reactions in aromatic compounds and their derivatives
- Addition reaction mechanism
- Oxidation reaction mechanism
- Elimination reaction mechanisms (E1 and E2)
- Mechanism of condensation reactions and carbonyl compounds
- Pericyclic and cycloaddition reaction mechanisms
- Free radical reaction mechanism
- Photochemical reaction mechanism
- Functional group interconversion reaction mechanism

6. Reading/Reference

- Clayden, Greeves, Warren and Wothers, (2001), Organic Chemistry, Oxford, New York, First edition
- McMurry, J., (2005), "Organic Chemistry," Brooks/Cole Publishing Company, Pacific Grove, California, 5th edition
- Carey, F.A and Sundberg, R.J. 2007. Advanced Organic Chemistry. Springer, New York, 5th edition
- RS Monson, 2002, Advanced Organic Synthesis, Methods and Techniques, Academic Press, New York

7. Task

Complete the questions related to each lecture and collect them in each subsequent lecture..



DOCUMENT: COURSE AGREEMENT

Code :	004/UN.11.2 /MKIM/KK/2024	Date of issue	: August 13 2025
Area :	Master in Chemistry Faculty of Mathematics and Natural Sciences, USK	Revision No.	:

8. Assessment Criteria and Standards

Assignment = 20% and Quiz = 20%
Mid-term examination = 30%; and final examination = 30%

Score Range	Quality Letter	Category	Graduation Status
≥87	A	Excellent	PASS
78 - <87	AB	Distinction	
69 - <78	B	Good	
60 - <69	BC	Fairly good	
51 - <60	C	Fair	
41 - <51	D	Poor	FAIL
<41	E	Fail	

9. Code of Conduct

Lecturer :

1. Begin and end each class session on time (a tolerance of up to 15 minutes for delay is acceptable)
2. Dress appropriately and modestly in accordance with cultural and religious values
3. Maintain professional and ethical behavior in speech and actions; uphold the principles of *Pancasila* and the Republic of Indonesia
4. Return midterm and final examination results to students within a reasonable period.
5. Do not alter or reschedule classes except when absolutely necessary
6. Ensure full attendance throughout the semester
7. Comply with the academic regulations of Universitas Syiah Kuala (USK) and the Faculty of Mathematics and Natural Sciences
8. Classes should not be conducted on public holidays unless strictly required and approved.

Student:

1. Arrive and leave the classroom punctually (with a tolerance of up to 15 minutes for lateness)
2. Dress modestly according to religious and cultural traditions.
3. Maintain respectful behavior and language, upholding the values of Pancasila and the Republic of Indonesia.
4. Refrain from using mobile phones, laptops, or any communication devices during lectures and examinations.
5. Avoid causing disturbances, noise, or distractions during class.
6. Attend at least 75% of total class sessions held by the lecturer to be eligible for assessment.
7. Adhere to the academic regulations of Syiah Kuala University (USK) and the Faculty of Mathematics and Natural Sciences.
8. Keep the classroom clean and tidy at all times.
9. After each lecture, ensure that electricity, LCD projector, and other equipment are turned off, the whiteboard is cleaned, and trash is properly disposed of.
10. Do not engage in activities unrelated to the course during lectures.
11. A follow-up exam can be carried out if you meet the applicable terms and conditions and can show proof.

10. course schedule

Week 4	Subject	Teaching Lecturer
1 and 2	Mechanism of nucleophilic substitution reactions •SN1 •SN2 •SNi	Muhammad Bahi, Ph.D
3 and 4	The mechanism of electrophilic substitution reactions in aromatic compounds and their derivatives	Muhammad Bahi, Ph.D
5	• Addition reaction mechanism • Mechanism of addition reactions of alkenes and alkynes	Muhammad Bahi, Ph.D
6	Oxidation reaction mechanism	Muhammad Bahi, Ph.D
7	Mechanism of condensation reactions and carbonyl compounds	Muhammad Bahi, Ph.D

DOCUMENT: COURSE AGREEMENT			
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8	Mid-term exam	Muhammad Bahi, Ph.D
9 and 10	Elimination reaction mechanism •E1 •E2	Prof. Dr. Binawati Ginting, M.Si
11 and 12	Reaction mechanismpericyclic and cycloaddition	Prof. Dr. Binawati Ginting, M.Si
13	Free radical reaction mechanism	Prof. Dr. Binawati Ginting, M.Si
14	Reaction mechanismphotochemistry	Prof. Dr. Binawati Ginting, M.Si
15	Reaction mechanismfunctional group interconversion	Prof. Dr. Binawati Ginting, M.Si
16	Final Exam	Prof. Dr. Binawati Ginting, M.Si

11. Evaluation

A. Attitude Assessment

The attitude aspects that are assessed are part of the course assessment for all aspects or assessment criteria and are included in the assignment grades, exams 1, 2 and 3. The attitude assessment section includes discipline and responsibility.

1) Discipline, Integrity, Cooperative Attitude.

No.	Observation Aspects	Score				
		4	3	2	1	0
1	Submit assignments on time					
2	Maintain regular attendance throughout the course					
3	Complete all assignments in accordance with the lecturer's instructions and academic standards					

Attitude Assessment Rubric:

Score 4 = Consistently demonstrates the described behavior at all times

Score 3 = Frequently demonstrates the described behavior most of the time, with occasional lapses.

Score 2 = Occasionally demonstrates the described behavior sometimes, but often fails to do so.

Score 1 = Rarely/never seldom or never demonstrates the described behavior

Score 0 = Did not attend lectures

$$\text{Attitude Value} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100\%$$

B. Knowledge Mastery Assessment

Knowledge or cognitive mastery is assessed by weighting each exam question according to its difficulty level. This cognitive score is generated on a scale of 0-100, and after summing each assessment item, it is converted into a letter grade.

12. Miscellaneous

Any matters not covered in this agreement may be discussed and addressed technically during the course sessions. If revisions to the contents of this course agreement are deemed necessary, they shall be discussed and mutually agreed upon prior to implementation. This course agreement shall take effect from the date it is submitted and signed by both parties.

Party I
Class Coordinator,


Muhammad Bahi, Ph.D
NIP. 197209281997021001

Party II
On behalf of Students


(Nisa Amlia)
Student ID. 2408203010002

Approved by,
Head of the Study Program


Dr. Surya Lubis M.Si
NIP. 196905101999032001

CHAPTER 4

PROGRAM EVALUATION DESIGN

4.1 Correlation Between Graduate Profiles and Intended Learning Outcomes (ILO)

The level of depth and breadth between the graduate profiles and the learning outcomes (ILO) is determined through an analysis of their correlation. The degree of correlation is represented by the letters H (High), M (Medium), and L (Low), where H corresponds to a score of 71–100, M to 41–70, and L to 0–40. Table 4.1 illustrates the correlation matrix between the Graduate Profiles and the ILOs of the Master in Chemistry Program.

Table 4.1. Correlation Matrix Between Graduate Profiles and ILOs

Graduate Profile	PL-01	PL-02	PL-03
ILO01	H	H	H
ILO02	H	H	M
ILO03	H	H	M
ILO04	H	H	H

* Note: L = Low (0–40); M = Medium (41–70); H = High (71–100)

The correlation between the components of the Graduate Competency Standards (SKL) is useful for analyzing their alignment with the ILOs of the Master in Chemistry Program. The SKL components, as defined in the Indonesian National Qualifications Framework (KKNI), consist of Attitudes and Values (S), General Skills (KU), Specific Skills (KK), and Knowledge Mastery (P). Table 4.2 summarizes the alignment between SKL and ILO components.

Table 4.2. Correlation Matrix Between ILOs (SNDikti/KKNI) and SKL Components

Competency (SKL)*	ILO01	ILO02	ILO03	ILO04
Attitudes and Values (S)	√			
Knowledge Mastery (P)				√
General Skills (KU)		√		
Specific Skills (KK)			√	

4.2 Correlation Between Courses and Learning Outcomes (ILO)

The Thesis course is selected as it has the highest relevance to the achievement of ILO. The ILO weight distribution across semesters 1 to 4 is shown in Table 4.3. In this table, the ILO are coded as 01, 02, 03, and 04. The contribution of each course to ILO achievement is exemplified by the Thesis course (8 credits), which contributes to all ILO (01 through 04). Given that the Thesis course carries 8 credits, the distribution of ILO contributions is determined by the program team as follows: ILO 01 contributes 10% (equivalent to 0.8 credits), ILO 02 contributes 30% (2.4 credits), ILO 03 contributes 30% (2.4 credits), and ILO 04 contributes 30% (2.4 credits). The percentage of assessment for a given ILO is calculated by dividing the total number of credits for that ILO by the total number of ILO-related credits (15). For example:

- ILO 01 has a total of 1.5 credits; therefore, $(1.5/15) \times 100\% = 10\%$
- ILO 02 has a total of 4.5 credits; therefore, $(4.5/15) \times 100\% = 30\%$

- ILO 03 has a total of 4.5 credits; therefore, $(4.5/15) \times 100\% = 30\%$
- ILO 04 has a total of 4.5 credits; therefore, $(4.5/15) \times 100\% = 30\%$

Table 4.3. Weighted Assessment Matrix for Intended Learning Outcomes (ILO) – Master of Science in Chemistry, USK

No	Code	Course Title	Credits (SKS)	ILO*				Total Weight
				01	02	03	04	
SEMESTER 1								
1	MMKM1001	Quantum Chemistry and Spectroscopy	2				2,0	2
2	MMKM1003	Inorganic Chemical Reactions	2				2,0	2
3	MMKM1005	Recent Methods in Chemical Separation	2	0,2	0,6	0,6	0,6	2
4	MMKM1007	Reaction Mechanism in Organic Chemistry	2				2,0	2
5	MMKM1009	Metabolic Engineering	2				2,0	2
6	FPPS1001	Research Methodology	2			2,0		2
7	MMKM1011	Laboratory Management	2				2,0	2
SEMESTER 2								
8	MMKM1002	Chemistry in Halal Products	2	0,4	0,8		0,8	2
9	MMKM1004	Capita Selecta	3			1,5	1,5	3
10	MMKM1006	Colloquium of Analytical Methods	2			1,0	1,0	2
11	MMPAP001	Thesis Proposal	2			1,0	1,0	2
SEMESTER 3								
12	MMKMP003	Scientific Seminar	2			0,8	1,2	2
SEMESTER 4								
13	MMKMP004	Scientific Publication	3	0,6	4,8	2,4	3,2	3
14	MMPAPA01	Thesis	8					8
ELECTIVE COURSES – 3 rd SEMESTER								
15	MMKM6013	Membrane Technology	2			1,0	1,0	2
16	MMKM6015	Modification of Inorganic Compounds	2				2,0	2

17	MMKM6017	Bioinorganic Applications	2				2,0	2
18	MMKM6019	Defined Analysis Techniques	2	0,2	0,6	0,8	0,4	2
19	MMKM6021	Validation of Analytical Methods	2	0,4		0,8	0,8	2
20	MMKM6023	Synthesis of Organic Chemistry	2		1,0		1,0	2
21	MMKM6025	Structure Elucidation of Organic Compounds	2			0,4	1,6	2
22	MMKM6027	Industrial Enzyme Technology	2				2,0	2
ELECTIVE COURSES – 2nd SEMESTER								
23	MMKM6004	Polymer Technology	2				2,0	2
24	MMKM6006	Applied Materials	2				2,0	2
25	MMKM6008	Complex Chemistry	2				2,0	2
26	MMKM6010	Inorganic Catalyst in Chemistry	2				2,0	2
27	MMKM6012	Advanced Chromatography	2				2,0	2
28	MMKM6014	Analysis of Environmental Chemistry	2				2,0	2
29	MMKM6016	Biosynthesis and Analysis of Natural Products	2				2,0	2
30	MMKM6018	Isolation Techniques in Organic Chemistry	2			2,0		2
31	MMKM6020	Bioassay Technology	2				2,0	2
32	MMKM6022	Fermentation and Bioprocess	2				2,0	2
Total Weight of Sample Assessment for Intended Learning Outcomes (ILO)			72	1,8	6,8	14,3	46,1	72
Percentage of Sample Assessment Weight for ILO			100%	2,5%	9,44%	19,86%	64,03%	100%

Key points to emphasize in measuring ILO attainment:

1. A single ILO may be achieved through several Course Learning Outcomes (CLO) distributed across multiple courses
2. CLO should remain consistent, even if the course title changes
3. Each ILO should ideally be linked to no more than four courses to facilitate calculation and monitoring
4. The number of CLO per course should not exceed five, although they may be elaborated through sub-CLO
5. Achievement of CLO within a course must be reflected 100% across all types of assessments used in the course.
6. A minimum score of >50 may be considered as a passing criterion for a specific CLO

Example of Student ILO Scores

Each student's score is calculated based on the attainment of ILOs incorporated into the respective courses.

NAME : Cantika Dwi Riski

STUDENT ID: 2308203010003

Sem	No	Code	Course	01	02	03	04
II	1	MMPAP001	Thesis Proposal	87	83	87	87
III	2	MMKMP003	Scientific Seminar	85	85	87	87
IV	3	MMKMP004	Scientific Publication	87	85	85	88
	4	MMPAPA01	Thesis	87	87	87	88
ILO Score				86,5	85	86,5	87,5

Note: ILO scores are calculated based on the weight of each course's ILO contribution relative to the total ILO weight.

Example of Intended Learning Outcomes (ILO/ ILO)-Based Academic Transcript:



KEMENTERIAN PENDIDIKAN TINGGI, SAINS,
DAN TEKNOLOGI
UNIVERSITAS SYIAH KUALA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
PROGRAM STUDI MAGISTER KIMIA
Jln. Syekh Abdurrauf No. 3, Darussalam, Banda Aceh 23111, Gedung B Lt. 2
Laman: <https://mkim.fmipa.usk.ac.id/> Surel: magisterkimia@fmipa.usk.ac.id

Intended Learning Outcome (ILO)-Based Academic Transcript

Name	: Cantika Dwi Riski	Faculty	: MIPA
Student ID	: 2308203010003	Program	: Master of Science in Chemistry
Place of Birth	: Batusangkar	Education Level	: Magister
Date of Birth	: 25 Agustus 2001	Graduation Date	: 29 Januari 2024

NO	Code	Program Learning Outcome (ILO)	Score	Category
1	ILO01	Have a sense of piety, ethical conduct, integrity, social consciousness, an innovative mindset, and a commitment to lifelong learning in accordance with academic standards.	86,5	Distinction
2	ILO02	Able to effectively manage research, make informed decisions, communicate effectively, and engage in intercultural collaboration to address complex problems.	85	Distinction
3	ILO03	Able to design and conduct innovative scientific research independently to address new and complex problems and produce work recognized nationally or internationally.	86,5	Distinction
4	ILO04	Possess in-depth knowledge in chemistry, specialized or interdisciplinary chemistry, for the development and application of original ideas.	87,5	Excellent

Grading Scale: 81 – 100 : Excellent
61 – 80 : Good
51 – 60 : Fair
<51 : Poor

Banda Aceh, February 5, 2024
Chairperson,

Dr. Surya Lubis, M.Si
NIP. 196905101999032001

To ensure that every graduate of the Master in Chemistry Program at Universitas Syiah Kuala (USK) has achieved all predetermined Intended Learning Outcomes (ILO), the following measures are implemented:

1. The Master in Chemistry Program sets the minimum passing standard for ILO attainment at a score of ≥ 61 (Good), with a target of *Excellent* achievement. ILO attainment levels are categorized as *Good* and *Excellent*.
2. The Program monitors each student's ILO attainment annually and provides recommendations for those whose achievement falls below the established target.
3. The Program issues a ILO Transcript for each student, while the Academic Transcript is issued by the Academic Affairs Office of the Faculty of Mathematics and Natural Sciences (FMIPA) after the *Yudisium* (Graduation Decision Meeting).

4.3 Monitoring of Teaching Implementation and Evaluation of Course Learning Outcomes (CLOs)

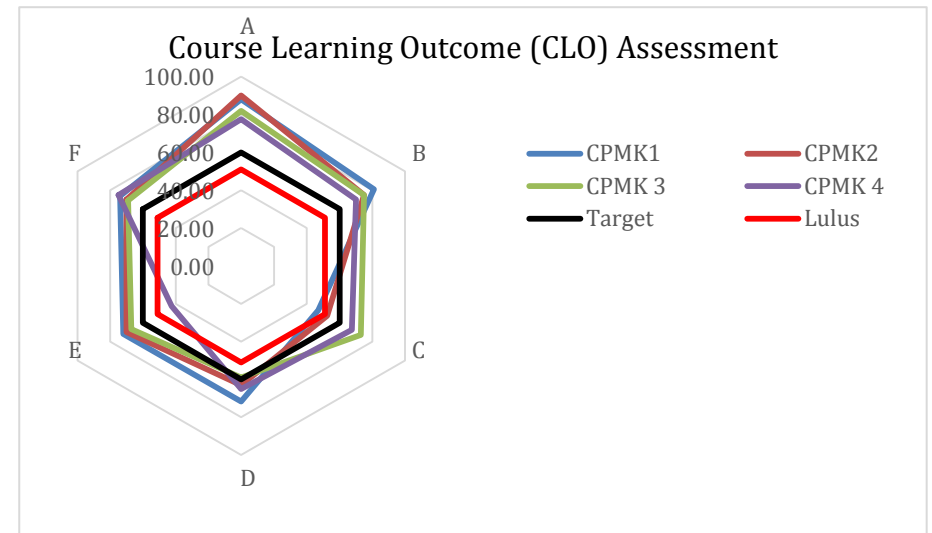
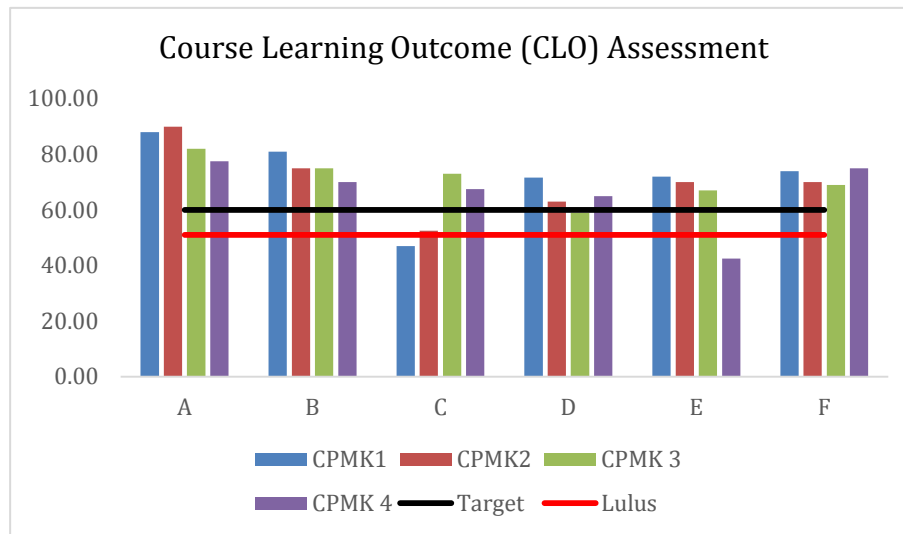
Monitoring of teaching implementation and evaluation of Course Learning Outcome (CLO) attainment within the Master in Chemistry Program is conducted as part of the PDCA (Plan-Do-Check-Act) cycle to ensure continuous improvement. This process emphasizes instructional content, teaching methods, assessment practices, and faculty attendance. Evaluasi pemenuhan CPMK ditekankan pada tingkat kelulusan setiap CPMK, nilai tertinggi, terendah dan rata-rata mahasiswa.

CLO evaluation focuses on the percentage of students achieving each CLO, including the highest, lowest, and average student scores. The procedures are as follows:

1. At the beginning of the semester, each lecturer is required to prepare a course control document in the form of a *Rencana Pembelajaran Semester* (Course Syllabus) and a teaching contract.
2. Lecturers are required to record class attendance and fill out the teaching activity monitoring form weekly via the university's learning management system (simkuliah.usk.ac.id).
3. Each course includes 16 sessions per semester, including midterm and final examinations.
4. At the end of each semester, students are required to evaluate the lecturer's performance by completing an online questionnaire via Google Forms.
5. Lecturers must evaluate the implementation of teaching and CLO attainment by completing a portfolio provided by the Program. The results are submitted to the Program for further review and program-level evaluation.
6. The Program Coordinator evaluates lecturer attendance, alignment between the syllabus (RPS) and its implementation, and the timeliness of final grade submission.

Evaluation of Course Learning Outcomes (CPMK) Achievement:

Student Name	Assessment Items								CLO Scores				ILO (cores)			Final Grade	
	Assignment 1	Assignment 2	Quiz 1	Quiz 2	Midterm Exam		Final Exam		ILO02	ILO03		ILO04	ILO02	ILO03	ILO04		
	CPMK1 CPKF01	CPMK2 CPKF02	CPMK3 CPKF03	CPMK4 CPKF06	CPMK1 CPKF01	CPMK2 CPKF02	CPMK3 CPKF03	CPMK4 CPKF06	CPMK1 CPKF01	CPMK2 CPKF02	CPMK3 CPKF03	CPMK4 CPKF06					
	10%	10%	15%	15%	15%	10%	10%	15%	25.0%	20.0%	25.0%	30.0%	25%	45%	30%	100%	In letter
A	100	90	80	70	80	90	85	85	88.00	90	82	77.5	88.00	85.56	77.5	84	AB
B	90	80	75	80	75	70	75	60	81.00	75	75	70	81.00	75.00	70	75	B
C	50	60	75	80	45	45	70	55	47.00	52.5	73	67.5	47.00	63.89	67.5	61	BC
D	89	56	45	60	60	70	80	70	71.60	63	59	65	71.60	60.78	65	65	BC
E	75	60	75	45	70	80	55	40	72.00	70	67	42.5	72.00	68.33	42.5	62	BC
F	80	60	75	90	70	80	60	60	74.00	70	69	75	74.00	69.44	75	72	B
rata	80.7	67.7	70.8	70.8	66.7	72.5	70.8	61.7	72.3	70.1	70.8	66.3	72.3	70.5	66.3	69.7	B



Analysis of Course Learning Outcomes (CLO) achievement:

- The minimum passing score for each Course Learning Outcome (Eng.: CLO/ Ind.: CPMK) is set at 51 (Letter Grade C) based on a 100-point scale. This indicates that students are expected to achieve at least 51% comprehension of the targeted learning outcomes. The expected class average for each CPMK is 60 (BC).
- Based on the data, the average CPMK scores exceed the target. However, two students (33.33% of the class) did not meet the minimum threshold for CPMK 1 and CPMK 4.
- Similarly, all students achieved an average ILO (Ind:CPL) score above 60, although two students fell below the passing mark for ILO01 and ILO04.
- The final class average grade is 69.7 (B).

Control Measures Implemented

Following the analysis of learning outcomes, further evaluation was carried out for the two students who did not meet the minimum CPMK threshold. Observations revealed that these students scored low on both the midterm and final exams. The course coordinator also confirmed irregular class attendance by the students. The primary challenge encountered by these students was insufficient readiness for exams, especially those requiring problem-solving and calculation-based tasks related to the course content. Consequently, they struggled to complete exam questions effectively.

Future Improvement Plan

Students who have not met a specific Intended Learning Outcome (ILO) will receive support through a remedial program, which may include additional lectures, retake examinations, or targeted assignments designed to reassess the achievement of Course Learning Outcomes (CLOs). The study program conducts annual assessments and evaluations of ILOs to monitor student learning outcomes and use the results as a basis for continuous improvement in the Master in Chemistry Program .

APPENDIX 1
Faculty Members – Master of Science in Chemistry
Faculty of Mathematics and Natural Sciences
Universitas Syiah Kuala

No	Name	NIP	Place of Birth	Date of Birth	Rank	Academic Position
1	Prof. Dr. Ir. Rosnani Nasution, S. Si., M. Si.	195712241991022001	Pematang Siantar	24-12-1957	IV/d	Professor
2	Prof. Dr. Mustanir M.Sc	196605101993031002	Lheu, Aceh Besar	10-05-1966	IV/e	Professor
3	Ptof. Dr. Nurdin M.Si	196609151991031005	Kp. S. Mulia	15-09-1966	IV/b	Professor
4	Prof. Dr. rer. nat. Ir. Rinaldi Idroes, S. Si.	196808251994031003	Sigli	25-08-1968	IV/e	Professor
5	Prof. Dr. Saiful, S.Si., M.Si	196909221994121001	Beruegang	22-09-1969	IV/d	Professor
6	Prof. Dr. Eka Safitri, S. Si., M. Si.	197001052000032001	Banda Aceh	05-01-1970	IV/c	Professor
7	Prof. Dr. Teuku M. Iqbalsyah M.Sc	197110101997031003	Medan	10-10-1971	IV/d	Professor
8	Prof. Dr. Rahmi, S. Si., M. Si.	197209271999032001	Baso	27-09-1972	IV/c	Professor
9	Prof. Dr. Binawati Ginting, S. Si., M. Si.	197209271999032002	Lubuk Pakam	27-09-1972	IV/b	Professor
10	Prof. Dr. Febriani S. Si, M. Si.	197202171999032001	Maninjau	17-02-1972	IV/b	Professor
11	Prof. Dr. Muliadi Ramli, S. Si., M. Si.	197303011998021001	Langugob, Aceh Besar	01-03-1973	IV/b	Professor
12	Prof. Dr. rer. nat Khairan M.Si	197506222005011001	Bireuen	22-06-1975	IV/b	Professor
13	Dr. Surya Lubis M.Si	196905101999032001	Balimbingan	10-05-1969	IV/b	Associate Professor
14	Dr. Khairi S. Si., M. Si.	196906141999031002	Bah Butong	14-06-1969	IV/b	Associate Professor
15	Dr. Lelifajri, S. Si, M. Si.	197002212000032002	Banda Aceh	21-02-1970	III/d	Associate Professor
16	Dr. Nurhaida, S. Si., M. Si.	197003301999032005	Banda Aceh	30-03-1970	IV/c	Associate Professor
17	Dr. Julinawati S.Si., M.Si	197107011997022001	Cot le Ju	01-07-1971	IV/a	Associate Professor
18	Muhammad Bahi, S. Si., M. Sc., Ph. D.	197209281997021001	Banda Aceh	28-09-1972	IV/b	Associate Professor
19	Dr. rer. nat. Ilham Maulana	197503061998021001	Bl. Uyok	06-03-1975	IV/a	Associate Professor
20	Dr. Nazaruddin, S. Si, M. Si.	197006211997031002	Blangkire	21-06-1970	III/c	Assistant Professor
21	Dr. Elly Sufriadi, S. Si., M. Si.	197103302000121001	Aceh Selatan	30-03-1971	III/c	Assistant Professor

Appendix 2

Table 1. ILO Statements – Master of Science in Chemistry

ILO Component	ILO Statement
ILO01 Attitude (S)	To have a sense of piety, ethical conduct, integrity, social consciousness, an innovative mindset, and a commitment to lifelong learning in accordance with academic standards.
ILO02 General Skills (KU)	To effectively manage research, make informed decisions, communicate effectively, and engage in intercultural collaboration to address complex problems.
ILO03 Specific Skills (KK)	To independently design and conduct innovative research aimed at addressing complex problems, and to produce work that receives national or international recognition.
ILO04 Knowledge Mastery (PP)	To possess comprehensive knowledge of chemistry, encompassing both specialized and interdisciplinary domains, to promote the development and application of original ideas.

APPENDIX 3

Table 2. Body of Knowledge in the Master in Chemistry Program

NO	CODE	BODY OF KNOWLEDGE	SUBTOPICS
1	BK-01	Structure, properties, energetics, and kinetics of chemical compounds	1. Structure, properties, reactions and reactivity, kinetics, thermodynamics, energetics, and stereochemistry 2. Molecular spectroscopy and quantum mechanics
2	BK-02	Techniques for the isolation, purification, and characterization of chemical compounds	1. Techniques for the isolation and purification of chemical compounds and biomolecules 2. Selection of instrumentation for the analysis and characterization of chemical compounds and biomolecules 3. Advances in methods for the isolation, purification, and characterization of chemical compounds and biomolecules
3	BK-03	Synthesis/biosynthesis and engineering of chemical compounds and biomolecules for useful applications	1. Chemical synthesis and engineering for compound production 2. Biosynthesis and engineering for biomolecule production
4	BK-04	Contemporary chemical research for societal well-being	1. Advances in contemporary chemical sciences 2. Applications of chemistry in industry and society
5	BK-05	Innovative scientific research	1. Work ethics, management of chemicals and laboratory equipment, laboratory design and standardizationPenelusuran literatur, formulasi permasalahan dan penulisan proposal riset 2. Literature review, problem formulation, and research proposal writing 3. Method selection and validation 4. Data collection, processing, management, and analysis 5. Presentation and communication of research findings 6. Scientific writing and publication

APPENDIX 4

Table 3. Course Learning Outcomes (CLO)

CLO Code	Course Learning Outcome Description
CPPS01	Able to select and design appropriate research methods for thesis work
CPPS02	Able to apply theoretical principles of work safety, manage laboratory equipment and chemicals, as well as design and standardize laboratories.
CPPS03	Able to review recent reputable journal articles and present them in academic forums
CPPS04	Able to disseminate chemical analysis methods from recent reputable international journals in seminar settings
CPPS05	Able to disseminate research designs and results related to thesis work
CPPS06	Able to produce scientific work recognized at the national or international level
CPPS07	Able to conduct in-depth analysis in chemistry, specialized chemical fields, or interdisciplinary areas to develop and apply original ideas
CPPS08	Able to conduct literature reviews, design research, report and disseminate results, and publish them in nationally accredited or international scientific journals
CPKF01	Able to understand and determine the chemical and mechanical properties of materials
CPKF02	Able to understand and calculate the energetics and kinetics of materials
CPKF03	Able to understand and explain atomic interactions and their applications
CPKF04	Able to develop and utilize polymers (both natural and synthetic) for diverse applications
CPKF05	Able to evaluate advancements in natural and synthetic polymers based on recent journal articles
CPKF06	Able to understand quantum chemistry and its applications, as well as analyze and interpret molecular structures using spectroscopic data
CPKF07	Able to design and engineer materials

CPKF08	Able to evaluate current research trends in material science
CPKF09	Able to master the key determinants of chemical reactions and synthesis of new compounds, types and properties of materials, and the design and engineering of materials for applications in research and industry
CPAN01	Able to analyze the structure, properties, reactions, and reactivity of inorganic compounds
CPAN02	Able to isolate, purify, modify, and characterize inorganic compounds
CPAN03	Able to explain the synthesis and modification of inorganic compounds for various applications
CPAN04	Able to explain recent research developments in inorganic chemistry and their applications
CPAL01	Able to evaluate processes in halal product development
CPAL02	Able to understand and explain methods, mechanisms, and applications of modern chemical separation techniques
CPAL03	Able to understand and explain concepts of modern chemical analysis, methodological development, and their applications
CPAL04	Able to interpret environmental quality based on analytical data
CPAL05	Able to apply and develop measurement principles and analytical parameters in experimental design and measurement processes
CPOR01	Able to analyze mechanisms of organic molecular reactions, including stereochemical, thermodynamic, and kinetic aspects
CPOR02	Able to perform and develop isolation and purification techniques for organic molecules
CPOR03	Able to explain the application of biosynthetic pathways in secondary metabolite compounds
CPOR04	Able to design the synthesis of organic compounds
CPOR05	Able to analyze the structure of organic compounds using various spectroscopic and analytical techniques for structural elucidation

CPBI01	Able to design bioassay technologies using diverse bioindicators for natural compounds
CPBI02	Able to isolate, purify, and characterize biomolecules
CPBI03	Able to identify and engineer metabolic pathways to produce targeted products
CPBI04	Able to apply fermentation processes to produce metabolites for various applications
CPBI05	Able to evaluate strategies for the discovery and development of novel enzymes