PROGRAMME STANDARDS: CHEMISTRY

First Edition

Programme Standards: Chemistry

First Edition 2024

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MESSAGE FROM THE PRESIDENT, INSTITUT KIMIA MALAYSIA

Institut Kimia Malaysia (IKM) is a professional scientific organization incorporated under the Chemists Act 1975 [Act 158] on 1st November 1977. According to the Act, one of the functions of the Institute shall be “to approve or refuse the granting of accreditation of chemistry and chemistry-related programmes in public higher educational institutions and private higher educational institutions in Malaysia in accordance with the Malaysian Qualifications Agency Act 2007 [Act 679].

We are pleased to announce that Institut Kimia Malaysia (IKM) has come up with a Chemistry Programme Standards for Malaysian universities. This Standard is developed upon a series of discussion and consultation with stakeholders and the Malaysian Qualification Agency (MQA). In accordance with the Chemists Act 1975, the Programme Standards is approved by the Malaysian Qualification Agency (MQA) for accreditation of undergraduate chemistry programmes in Malaysian universities with MQA.

IKM and MQA will manage the accreditation process including evaluation and assessment of Malaysian undergraduate chemistry programmes applying for accreditation. Universities can apply for accreditation of their undergraduate chemistry programmes with MQA starting June 2025. MQA will process the accreditation application and the accreditation panel report will be submitted to IKM Council for deliberation and approval.

The Chemistry Programme Standards developed by IKM is listed here in this document for public viewing. IKM is honoured to be given this task by MQA to accredit Malaysian undergraduate chemistry programmes in accordance with Chemists Act 1975. We want to ensure that Malaysian chemistry programmes keep abreast with the latest development in chemical sciences and maintain a high level of academic excellence.

Datuk ChM Dr Soon Ting Kueh
President, Institut Kimia Malaysia
Date: 30th June 2024

MESSAGE FROM THE CHAIRMAN, IKM-MQA JOINT TECHNICAL COMMITTEE

Institut Kimia Malaysia (IKM) is a statutory professional body incorporated under the Chemists Act 1975 and serves as the custodian of registered chemists in Malaysia. To apply as a registered Chemist, one must possess a degree in Chemistry recognized by the government. Many Chemistry degree programs have been offered by our local universities since the early 1960s. Currently there are 35 chemistry programme offered by our local universities, each having their own course contents. Chemistry can cover a very diverse areas dealing with synthesis, structure, reaction mechanism, properties, characterization and analysis, applications. Each of these degree program titles may or may not carry the word 'chemistry' and the knowledge level of chemistry contents may vary widely from program to program. And not necessarily all of them would cover the very basic aspect of chemistry represented by physical, inorganic and organic chemistry and the laboratory practical training components of these. Thus, graduates of some of these 'so-called' chemistry degrees have found themselves lack of adequate subject contents to qualify for admission as chemist when they apply for IKM membership.

To address this issue and to ensure all graduates of chemistry degree programme offered by local universities are adequately equipped with the relevant knowledge of chemistry to meet current and future needs of the nation with respect to skilled workforce, a Chemistry Degree Standards has been designed and formulated by IKM and subsequently endorsed by MQA. This Programme Standards (PS) document provides a guide for the Bachelor's Degree in Chemistry to be offered by local universities. To align with the requirement of Section 51 of the Malaysian Qualifications Agency Act 2007 (Act 679), the Agency has together with IKM established a Joint Technical Committee (JTC) to manage the accreditation of the Programme Standards. Graduates from the Chemistry programme accredited jointly by IKM and MQA are eligible to apply as registered chemist with IKM. The PS also serves as a reference for Higher Education Providers (HEPs) in developing and offering Chemistry programme. The aspirations of Malaysia Education Blueprint 2015-2025 (Higher Education) and Malaysia Higher Education 4.0 have also been incorporated into the PS. There are five core disciplines in the Programme Standards, namely Analytical Chemistry, Inorganic Chemistry, Organic Chemistry, Physical Chemistry and Chemical Safety.

These disciplines will provide the basics and foundation to other chemistry applications upon which Elective disciplines such as Green Chemistry, Nano Chemistry, Medicinal Chemistry, etc. could be developed. The Electives cut across all the main disciplines of Chemistry and meet the wide range of specific regimes of chemical sciences that will propel us into the future. The PS encompasses mandatory laboratory-based training and internship with chemistry related industries. The total number of graduating credits is 120 (minimum).

Academician ChM Dr Ho Chee Cheong
Chairman, IKM-MQA Joint Technical Committee
30 June 2024

ABBREVIATIONS

COPIA	Code of Practice for Institutional Audit
COPPA	Code of Practice of Programme Accreditation
GGP	Guidelines to Good Practices
GP	Grade Point
HEPs	Higher Education Providers
IELTS	International English Language Testing System
IKM	Institut Kimia Malaysia
JPT	Jabatan Pengajian Tinggi/Higher Education Department
MOE	Ministry of Education
MQA	Malaysian Qualifications Agency
MQF	Malaysian Qualifications Framework
MUET	Malaysian University English Test
PS	Programme Standards
SKM	Sijil Kemahiran Malaysia
SPM	Sijil Pelajaran Malaysia
STAM	Sijil Tinggi Agama Malaysia
STPM	Sijil Tinggi Persekolahan Malaysia

GLOSSARY

1) Assessment as Learning	Assessment as learning is the student learning process where they monitor their own learning and become aware of how they learn.
2) Assessment for Learning	Assessment for learning is also known as formative assessment. It is an approach that enables teachers and learners to decide where the learners are in their learning and the information can be used in deciding what strategies to use in teaching and learning respective.
3) Assessment of Learning	Assessment of learning is sometimes referred to as 'summative assessment', typically administered at the end of a unit or grading period and may be used to rank or grade students.
4) Blended learning	An approach to education that combines online educational materials and opportunities for interaction online with physical place-based classroom methods
5) Core	Required courses related to areas of Chemistry.
6) Continuous Assessment	The assessment of student progress throughout a course using a series of methods which may include, but are not limited to, essays, quizzes, test(s), oral presentations and individual/group assignments/projects.
7) Dissertation	Refers to the documentation of the original research prepared and submitted by the candidate for the award of the degree.
8) External Reviewer	External reviewer refers to qualified person(s) to give feedbacks.
9) Final Assessment	Assessment of student attainment at the end of a course which can be in the form of a final examination, lab assessment, presentation, dissertation/thesis, project or industrial training report.
10) Final Examination	An examination or test scheduled within an official examination period held at the end of an academic term. It serves as the final evaluation of a course or courses of study which contributes to the overall academic performance of students.

11) Final Year Project	Refers to the documentation of the research or any applied project prepared and submitted by the candidate for the award of Bachelor degree by coursework.
12) Flipped Learning	Flipped learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic and interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.
13) Formative Assessment	The assessment of student progress at the end of a course in the form of a formal examination, dissertation/thesis, projects or industrial training report.
14) Industrial Training	A period of time within the programme when students are required to be placed in the industry to experience the real working environment.
15) Interactive Learning	Interactive learning is a two-way pedagogical approach which involves hands-on and work-based processes of delivering information to students.
16) Project Paper	Refers to the documentation of the research or any applied project prepared and submitted by the candidate for the award of the master's and doctoral degree programme by coursework.
17) Related Field	A field of study with a similar curriculum of study is referenced by a different name.
18) Specialised Programme	The programme core is designed to prepare students in a specific area of Chemistry.
19) Summative Assessment	Summative assessment is the assessment of learning, which summarises the progress of the learner at a particular time and is used to assign the learner with a course grade

1. INTRODUCTION

Chemistry is a wide-ranging science concerned with matter at the atomic and molecular scale. Important aspects are synthesis, structure, reaction mechanisms, properties, analysis and transformations of all types of materials. Chemistry is often referred to as the central science because it joins together physics and mathematics, biology and medicine, and the earth and environmental sciences. Knowledge of the nature of chemicals and chemical processes therefore provides insights into a variety of physical and biological phenomena. Chemistry is essential for meeting our basic needs of food, clothing, shelter, health, energy, and clean air, water, and soil. Chemical technologies enrich our quality of life in numerous ways by providing new solutions to problems in health, materials, and energy usage. Chemistry can contribute to the achievement of a number of the United Nations Sustainable Development Goals (United Nations, 2015) in the areas of food security, healthcare, economic growth and environment as well as being one of the key drivers of industry revolution 4.0.

Earning a degree in chemistry provides opportunities to a wide variety of careers in many different fields including science, research, business and healthcare. Degree holders in Chemistry can pursue careers such as academicians, researchers, executives, science communicators, science officers, product specialists, consultants and entrepreneurs. In Malaysia, Chemists are professionals under the Chemists Act 1975 (Act 158). Institut Kimia Malaysia (IKM), or the Malaysian Institute of Chemistry, is a statutory professional organization incorporated under the Chemists Act 1975 on 1st November 1977 and is under the jurisdiction of the Ministry of Science, Technology & Innovation (MOSTI).

This Programme Standards document provides a guide for the Bachelor's Degree in Chemistry, for which reference is made to Institut Kimia Malaysia (IKM) Manual. This is consistent with Section 50 (4) of the Malaysian Qualifications Agency Act 2007 (Act 679) which stipulates that the Agency should consult a Joint Technical Committee. In this case, the JTC was established by Institut Kimia Malaysia. Graduates from the Chemistry programme accredited by IKM qualify to apply as registered chemist with IKM.

This PS specifies the minimum requirements of Bachelor's Degree (Level 6, MQF) programme. It aims to provide a pathway for the students after their graduation to be chemists in the workforce or pursue further postgraduate study. The programme design will equip the students with the necessary knowledge and skills to meet the knowledge and manpower requirement of future job market. From the programme, the student will acquire a strong chemistry background with adequate laboratory skills.

There are five disciplines in Chemistry

i. Analytical Chemistry
ii. Inorganic Chemistry
iii. Organic Chemistry
iv. Physical Chemistry
v. Chemical Safety

These disciplines will provide the basics to other chemistry applications such as Environmental Chemistry, Nanochemistry, Energy, etc. Some are interdisciplinary in nature and these areas cut across all the main disciplines of Chemistry. **Table 1** provides the description of the five disciplines which may have common and overlapping areas/tools/products/services.

TABLE 1. DESCRIPTION OF MAIN CHEMISTRY DISCIPLINES

Disciplines	Definition	Examples of Areas/Tools/ Products/Services
Analytical Chemistry	Analytical Chemistry deals with the identification of compounds and mixtures (qualitative analysis) or the determination of the proportions of the constituents (quantitative analysis): techniques commonly used are titration, precipitation, spectroscopy, chromatography	• Quality Assurance and Quality Control • Analysis of Drugs and Medicine. • Soil Testing for Minerals and Nutrients • Chromatography • Pesticide Residues • Food Contaminants • Forensic Science, • Clinical Analysis, • Environmental Analysis.

Inorganic Chemistry	Inorganic chemistry is concerned with the properties and behaviour of inorganic compounds, which include metals, minerals, and organometallic compounds.	• Catalysts • Pigments, Paints and Ink • Coatings • Surfactants • Energy • Medicines • Fertiliser • Metal Ores • Microchips • Ceramic Chemistry • Coordination Chemistry
Organic Chemistry	Organic chemistry is the study of the structure, properties, composition, reactions, and preparation of carbon-containing compounds, which include not only hydrocarbons but also compounds with any number of other elements, including hydrogen, nitrogen, oxygen, halogens, phosphorus, silicon, and sulphur.	• Petroleum • Pharmaceuticals • Polymer Chemistry • Personal Care Products and Cosmetics • Rubber, • Detergent, • Coatings and Dyestuff, • Agrichemical Industries, • Fats and Oils • Biochemistry • Natural Products
Physical Chemistry	Physical chemistry is the study of macroscopic, atomic, subatomic, and particulate phenomena in chemical systems in terms of the principles, practices, and concepts of physics	• Chemical Equilibrium • Quantum Chemistry • Chemical Kinetics • Thermodynamics • Photochemistry • Surface Science • Thermochemistry • Gaseous States • Solid State • Phase Equilibria • Electrolytes and Electrochemistry • Surface Chemistry • Molecular Chemistry
Chemical Safety	Chemical safety is the practice of using occupational chemical substances in a manner that ensures the safety and health of humans and prevents damage to the environment. It covers all aspects of chemical use, including the	• OSHA Act 514 • Laboratory Management System • Laboratory Accreditation

	manufacture, transport, use, and disposal of chemicals	• Management of Chemicals in Laboratories • Management of Chemical Waste • Classification and Labelling of Chemicals

This 'Programme Standards: Chemistry' will be a reference for Higher Education Providers (HEPs) in developing and offering Chemistry programmes. This PS is timely and inevitable to remain relevant to national priorities and it is important that HEPs align their programmes with one or more of the Sustainable Development Goals (SDG); to incorporate emerging disciplines, technologies and tools; and to fulfil stakeholders' needs. It aligns to the Malaysian Qualifications Framework (MQF) 2nd Edition and Code of Practice for Programme Accreditation (COPPA) 2nd Edition as well as incorporating relevant stakeholders' feedback obtained from an impact study (MQA, 2017) and stakeholders' workshop (Stakeholders' Workshops for Review of Programme Standards: Chemistry on 1st - 2nd August 2018, and 17th April 2019, at Novotel, Kuala Lumpur). Strategic directions of Malaysia Education Blueprint 2015-2025 (Higher Education) and Malaysia Higher Education 4.0 were also taken into consideration.

The features of the Programme Standards (PS) are as follows:

i. The format presented in the seven quality assurance areas of the standards is aligned with the COPPA 2nd Edition.
ii. Statements for programme educational objectives and learning outcomes for each level of qualification are aligned with the MQF 2nd Edition.
iii. The PS is aligned with the Standards.
iv. An expanded list of suggested courses for each level of study (body of knowledge) is presented.
v. A percentage range is suggested for the continuous and final assessments are suggested to give more flexibility for the overall assessment.
vi. Minimum entry requirements of students for each level of study are set.
vii. Minimum qualifications of academic staff for each level of study are set.

viii. Teaching facilities and educational resources are updated to reflect current industry practices.
ix. Examples of programme nomenclature complying with the Policy on Nomenclature of Malaysian Higher Education Programme are provided.

To produce graduates qualified in the field of Chemistry at the Bachelor's Degree (Level 6, MQF), the benchmarks leading to the award of individual qualifications are given in these sections:

i. Programme Development and Delivery
ii. Assessment of Student Learning
iii. Student Selection
iv. Academic Staff
v. Educational Resources
vi. Programme Management
vii. Programme Monitoring, Review and Continual Quality Improvement

This PS should be viewed as a benchmark statement and not as a syllabus and no form of prescription is intended for the amount of time devoted to each area or the order in which the materials are delivered. HEPs are encouraged to go beyond the basic minimum where they should be innovative in terms of customising, organising, teaching and assessing their programmes and specific subject matters to meet the current and future national and global needs of the industry and society. Hence, HEPs must take cognisance of the rapidly evolving subject matter and introduce effective and sustainable programme improvements.

As the purpose of this PS is to provide guidelines pertaining to the development and conduct of Chemistry Bachelor's Degree (Level 6, MQF) programmes within the body of knowledge described, it is paramount that this PS is read with other quality assurance documents and policies issued by the MQA and other related agencies, which include, but are not limited to the following:

i. The Malaysian Qualifications Framework (MQF) 2nd Edition.
ii. The Code of Practice for Institutional Audit (COPIA)
iii. The Code of Practice for Programme Accreditation (COPPA) 2nd Edition

iv. The Code of Practice for Open and Distance Learning (COPPA:ODL) 2nd Edition
v. Relevant Standards
vi. Relevant Guidelines to Good Practices (GGP)

2. PROGRAMME DEVELOPMENT AND DELIVERY

For this PS, reference is made to the section on Area 1: Programme Development and Delivery**,** the Code of Practice for Programme Accreditation (COPPA). The programme educational objectives (PEO) are broad statements that describe the career and professional accomplishments that the programme is preparing the graduates to achieve after they graduated.

"The quality of a programme is ultimately assessed by the ability of the graduates to carry out their expected roles and responsibilities in society. This requires the programme to have a clear statement of the competencies, that is, the practical, intellectual and soft skills that are expected to be achieved by the students at the end of the programme" (COPPA 2nd Edition, 2017).

2.1 PROGRAMME EDUCATIONAL OBJECTIVES

The Programme Educational Objectives (PEOs) are described in a broad and general statement of learning and teaching intention, encapsulating the general contents and direction of a programme. The programme aims to provide graduates with a broad-based educational background and skills which equip them with abilities in design and providing solutions to complex and multi-faceted chemical problems.

A clear and appropriate statement of aims forms an important element in programme design and quality assurance, focusing on student learning experiences. A good formulation of aims enables a clear understanding of what the programme intends to achieve.

The PEOs for the Bachelor's Degree level are to provide learners with a thorough comprehension of a broad-based and coherent discipline and skills in the Chemistry discipline embedding research, innovation and creativity in specialised areas.

Graduates should demonstrate professionalism, resilience, commitment to an ethical work culture as well as awareness of sustainability issues and global citizenship in alignment with national aspirations.

2.2 LEARNING OUTCOMES

The quality of a programme is ultimately assessed by the ability of its graduates to carry out their expected roles and responsibilities in society. This requires a clear statement of the competencies, i.e., the practical, intellectual and soft skills that are expected to be achieved by the student at the end of the programme. The main domains of learning outcomes cover knowledge, practical and social skills, critical and analytical thinking, values, ethics and professionalism. The levels of competency of these learning outcomes are defined in the Malaysian Qualifications Framework (MQF) (COPPA 2nd. Edition, 2017).

The generic learning outcomes are intended to provide a framework to reduce the gap between the world of education, work and responsible global citizenship and to further harmonise/integrate the systems. This is demonstrable by the skills and knowledge of learners to successfully perform in professional, educational, and other life contexts. The learning outcomes resonate and mostly align with the aspirations of the National Education Philosophy (1961, 1988), the Malaysia Education Blueprint 2013−2025 and the Malaysia Education Blueprint 2015−2025 (Higher Education).

The learning outcomes clarify the demands and complexities of learning, relating to various levels of taxonomy at each level. It is within the context of study and/or work/practice situations, where for example, knowledge and understanding is required concurrently as these traits are dominant and important in pursuing higher education and advanced skills training.

The learning outcomes in the Chemistry field should cumulatively reflect the following five clusters of learning outcomes (MQF 2nd. Edition, 2018) meant to develop well-balanced individuals with a holistic set of competencies:

i. Knowledge and understanding
ii. Cognitive skills
iii. Functional work skills with focus on:

a. Practical skills
b. Interpersonal and communication skills
c. Digital and numeracy skills
d. Leadership, autonomy and responsibility

iv. Personal and entrepreneurial skills
v. Ethics and professionalism.

Considering the stated learning outcomes, the programme must indicate the career and further studies options available to students upon programme completion. Learning outcomes are statements described in explicit terms of learners' achievement upon completion of a period of study.

Upon completion of the programme, graduates should be able to:

1. describe, interpret and apply knowledge and skills in chemistry;
2. assess and analyse issues of chemistry in workplaces and the community;
3. interpret, analyse, synthesise and recommend preventive and corrective measures in chemistry;
4. educate and employees, employers and the community on chemistry;
5. apply evidence-based scientific principles in discussing ideas of improvement in chemistry;
6. demonstrate sensitivities and responsibilities towards the community, culture, religion and environment;
7. communicate in verbal and written forms with workers, other chemistry professionals, stakeholders, and the community at large;
8. identify and analyse critically chemistry problems to provide solutions based on evidence;
9. conduct research related to chemistry under supervision;
10. utilise ICT and information management system to enhance their chemistry practices;
11. demonstrate leadership, interpersonal and social skills;
12. apply skills and principles of lifelong learning in career development;
13. apply broad business and real-world perspectives in workplace and demonstrate entrepreneurial skills; and

14. adhere to the legal, ethical principles and the professional code of conduct in chemistry.

2.3 CURRICULUM DESIGN AND DELIVERY

For the purpose of this Programme Standards document, reference is made to the Code of Practice for Programme Accreditation (COPPA) and in particular, the section on Area 1: Programme Development and Delivery.

“The quality of programme is ultimately assessed by the ability of its graduates to carry out their expected roles and responsibilities in society. This requires a clear statement of the competencies, i.e., the practical, intellectual and soft skills that are expected to be achieved by the student at the end of the programme" (COPPA 2nd. Edition, 2017). “A programme is designed and delivered to facilitate the attainment of a set of desired learning outcomes. It starts with a clear definition of the intended outcomes that students are to achieve by the end of the programme and supported by appropriate instructional approaches and assessment mechanisms (constructive alignment)” (COPPA 2nd. Edition, 2017).

Curriculum design for academic programs should take into account three (3) course components, General Courses, Core Courses and Elective Courses. Generally, the curriculum of the academic program designed to comply with the minimum credit requirements is in accordance with the MQF standard. **Table 2 and Table 3** provides the three (3) related components of the course as well as the credit score range guidelines for the course components in designing the curriculum for MQF Level 6 academic programs. Discipline and core courses are given in Appendix 3.

TABLE 2: COURSE COMPONENTS FOR SINGLE MAJOR

BACHELOR'S DEGREE Graduating Credit = 120		
Component		**Minimum Credits**
General Courses* (MPU, HEPs courses)		8
Core**	Common	16
	Discipline	40
	Final Year Project***	8
	Industrial Training****	12
Remaining Credit (Electives/ Specialisation*****)		36
Total		120

Note:

*8 credits as prescribed by the *Garis Panduan Mata Pelajaran Pengajian Umum (MPU) Edisi Kedua.* The Subject-components for Generic-skills may be integrated or embedded into the core or elective components.

**The core courses should include 16 credits of practical/laboratory. Practical can be incorporated into a course. For example, a course can be 2+1 meaning 2 credits for theory and 1 credit for practical.

***Final Year Project should be laboratory-based.

****1 credit equal to 2 weeks of industrial training

*****Specialisation must be related to chemistry

1 credit of practical session equals to minimum of 2 hours of laboratory works

A program offering Chemistry as minor/major must fulfil total core credits.

TABLE 3: COURSE COMPONENTS FOR MAJOR-MINOR (MINIMUM 125 CREDITS)

BACHELOR'S DEGREE Graduating Credit = 125		
Component		**Minimum Credits**
General Courses* (MPU, HEPs courses)		8
Core**	Common	16
	Discipline	40
	Final Year Project***	8
	Industrial Training****	12
Electives		18
Minor		23
Total		125

Note:

*8 credits as prescribed by the *Garis Panduan Mata Pelajaran Pengajian Umum (MPU) Edisi Kedua.* The Subject-components for Generic-skills may be integrated or embedded into the core or elective components.

**The core courses should include 16 credits of practical/laboratory. Practical can be incorporated into a course. For example, a course can be 2+1 meaning 2 credits for theory and 1 credit for practical.

***Final Year Project should be laboratory-based.

****1 credit equal to 2 weeks of industrial training

Recommended Delivery Methods:

- Lectures/tutorials
- Practical classes/laboratory work
- Blended learning/MOOC
- Industry speaker
- Field/industry visits
- Industrial training
- Problem-based learning
- Project-based learning
- Final year project
- Seminar

3. ASSESSMENT OF STUDENT LEARNING

"Assessment of student learning is a key aspect of quality assurance and it is one of the most important measures to show the achievement of learning outcomes. Hence, an appropriate assessment method and mechanism should be in place. Qualifications for a degree are awarded based on the cumulative results of the courses taken. The methods of student assessment must be clear, consistent, effective, reliable and in line with current practices. They must clearly measure the achievement of the intended learning outcomes" (COPPA 2nd Edition, 2017).

The methods of assessment depend on the specific requirements of each course/ module. However, as a general guide, the following must be considered:

1) The usage of summative and formative assessments;
2) Knowledge and understanding (the cognitive domain) should be assessed through written, oral or other suitable means but practical skills should be assessed by practical evaluation such as laboratory, workshop, computer-based simulation and project work;
3) For courses/modules requiring significant practical skills, a pass in practical evaluation is compulsory. (A pass implies that the examiner, using an appropriate assessment tool, is satisfied that the candidate has met the learning outcomes of the course/module);
4) The following types of assessment indicated are merely examples. HEPs are encouraged to use a variety of methods and tools appropriate for measuring learning outcomes.

As a general guide, the following should be considered:

- Bachelor's Degree, depending on the requirements of individual subjects/ modules, Candidates are required to pass BOTH continuous and final assessments for every course. HEPs can define the meaning of a pass; however, a pass should imply that the examiner is satisfied that the candidate has met all the learning outcomes of the particular course; and
- Higher Education Providers (HEPs) are encouraged to use a variety of methods and tools appropriate to the learning outcomes and competencies. The types of assessments shown below are examples.

- Open/Closed Book Examinations
  - Multiple choice questions
  - Short answer questions
  - Mixed essay questions
  - Problem-based essay questions
- Continuous Assessments
  - Critical review of published articles
  - Presentation
  - Class Participation
  - Report-writing
  - Laboratory skills
  - Assignment/Mini project
- Research Project with Project Report/Dissertation/Viva Voce

4.0 STUDENT SELECTION

This section of the Programme Standards concerns the recruitment of candidates into the individual programme of study.

"In general, admission to a programme needs to comply with the prevailing policies of the Ministry of Education. There are varying views on the best method of student selection. Whatever the method used, the Higher Education Provider (HEP) must be able to defend the consistency of the method it utilises. The number of students to be admitted to a programme is determined by the capacity of the HEP and the number of qualified applicants. HEP admission and retention policies must not be compromised for the sole purpose of maintaining a desired enrolment. If an HEP operates in geographically separated campuses or if the programme is a collaborative one, the selection and assignment of all students must be consistent with national policies" (*COPPA 2nd* Edition, 2017).

The standards for the recruitment of students are formulated keeping in mind the generic National Higher Education policies pertaining to the minimum student entry requirements. The HEPs must take cognisance of any specific policies that may apply to their individual institution. The minimum requirements are as stated in **Table 4**.

TABLE 4. STUDENT'S ENTRY REQUIREMENT FOR MQF LEVEL

MQF Level	Entry Requirement	English Competency Requirement (International Student)
Bachelor's Degree	A pass in STPM with a minimum of Grade C (GP 2.00) in Chemistry OR A Diploma (Level 4, MQF) in the relevant fields with at least CGPA of 2.00 OR A certificate in matriculation in science. OR Other equivalent qualifications recognized by the Malaysian Government	International students are required to achieve a **minimum** score of 5.0 in IELTS **OR** Band 3.5 in MUET **OR** its equivalent.

5. ACADEMIC STAFF

As the quality of the academic staff is one of the most important components in assuring the quality of higher education, a HEP is expected to search for and appoint the best-suited candidates to serve its programmes in an open, transparent and fair manner. To achieve this, HEPs are expected to design and implement an academic staff search and recruitment practice that is as efficient as it is effective to achieve the desired results. It is important that every programme has appropriately qualified and sufficient number of academic staff, working in a conducive environment that attracts talented individuals. The numbers recruited have to be adequate for, and appropriate to, the needs of the programmes. The role of the academic staff in various activities has to be clarified in order to reflect a fair distribution of responsibilities. It is important for the HEP to provide a continuous staff development programme for its academic staff, for them to be current in their knowledge and skills, both in their chosen discipline as well as in their pedagogical skills" (*COPPA 2nd Edition, 2017*).

The HEPs must ensure that the academic qualifications of their academics are accredited by the relevant accreditation bodies. It is also the responsibility of the HEPs to ensure appropriate qualification is considered for the recruitment of staff in relation

to the courses offered. It would also be advantageous to the HEPs to hire those with a certain number of years of working experience due to greater versatility. As a general guide, it is important to note that the academic staff should have the relevant expertise or training in the courses taught. HEPs should also strive towards maintaining a balance between senior and junior academic staff.

The specific recruitment criteria of academic staff for each level are as indicated in **Table 5**.

TABLE 5: RECRUITMENT CRITERIA OF ACADEMIC STAFF

MQF Level	**Recruitment Criteria**	**Composition of Academic Staff**
Bachelor's Degree	A minimum of a Master's degree in a related field; **AND** A Bachelor's degree in a related field. OR A Bachelor's Degree* (Level 6, MQF) in related fields with FIVE (5) years of working experience** in the subject taught. *The number of staff with this qualification should not exceed 30% of the total academic staff.	Academic staff ratio i. In addition to observing staff to student ratio, the programme must consist of academic staff with expertise or background contributing to the related discipline core offered. ii. At least 60% of the academic staff are full-timers. iii. Part-time staff may consist of industry practitioners or from the academia. iv. The minimum number of academic staff in the related field for each programme–10**, with at least 4 academic staff must be registered chemists by IKM. Staff-student ratio i. Lecture – 1:30 ii. Practical – 1:20 iii. Tutorial – 1:20

*The experience acquired shall be after obtaining the required qualification. An exemption is provided to candidates with a Master's degree (for Bachelor's level), where the three years of work experience can be counted from the commencement of Master's studies, only if the programme has a significant clinical component.

**Refer to *Surat Makluman MQA Bil. 7/2014 – Garis Panduan Beban Staf Akademik*.

Academic Staff Development

To deliver quality programmes, to produce graduates who are marketable and to keep up with the rapid advancement in the fields of Chemistry, quality academic staff would need to be employed and provided with continuous trainings. HEPs should provide the following development programmes, amongst others:

i. Academic staff exchange and participation in national and international partner institutions as well as industry attachment should be highly advocated by the HEPs in ensuring that their academics get acquainted with different work settings. This will allow mentoring junior scholars and researchers and working with colleagues within the same, similar or even different research disciplines, consequently building stronger and wider professional networks. Additionally, this may lead to the broadening of the multi-disciplinary horizons at the HEPs.
ii. The academics need to be provided with professional development opportunities to support their expertise and skills in contemporary teaching, learning, assessment and research practices*.
iii. The academics should strongly be encouraged to pursue higher academic degree or professional certifications.

*Note: Although HEPs may plan custom training sessions for their staff based on demand, it is expected that the academics engage in the Continuous Professional Development (CPD) according to the specialisation needs with at least 40 hours of relevant training per year or participation in their respective field of expertise inclusive of research, consultation and community service. Part-time and/or contract staff should also be considered for the professional development programmes.

6. EDUCATIONAL RESOURCES

HEPs are required to provide sufficient resources to support learning and teaching in the various areas of chemistry at various qualification levels. HEPs must ensure that relevant educational resources and training facilities are in good working conditions and are available to support the learning and teaching activities as required by the respective areas of study. These include all the required physical facilities, information and communication technologies, research facilities, and finance (*COPPA 2nd* Edition, 2017). In addition, the HEPs must comply with the provisions of safety and health as

prescribed under the Occupational Safety and Health Act, 1994 (Act 514, 2022) and any other regulations/guidelines as stipulated by the relevant ministries/agencies. Educational resources recommended for Chemistry programmes include:

A. Basic Facilities

HEPs should provide lecture rooms, laboratories, seminar rooms, tutorial rooms and computers with internet facilities. Laboratories should be equipped with relevant instruments, apparatus and chemicals to perform chemistry experiments and research for the full duration of the program. Besides that, safety kits and personal protection equipment should be provided.

B. Specialised Facilities

HEPs should provide chemical storage facilities, waste storage facilities and instrumentation facilities.

C. Library

i. The HEPs must provide adequate library facilities including e-library; and

ii. The library must have an adequate collection of up-to-date reference materials required to support the needs of each programme and research amongst staff and students.

D. Non-Academic Resources

i. Non-Academic Resources fall under a wide umbrella of facilities and resources not directly academic but necessary for supporting the teaching-learning activities of the HEPs;

ii. The HEPs are required to provide among others resources to support students' extra-curricular activities, such as sports, recreational and community-based activities;

iii. Student lounges with internet facilities, which are necessary for student relaxation, must be adequately provided;

iv. HEPs must also provide sick-bay/accessible medical attention and counselling room where specific needs of their students can be met; and

v. Non-academic resources also refer to sufficient and appropriate physical facilities for the physically-challenged.

E. Support and Technical Staff

i. The technical staff in a Chemistry programme include laboratory assistants and/or science officers;

ii. The HEP determines the allocation of support staff to assist in the delivery of the programme; and

iii. The HEP should also facilitate continuous professional development opportunities for the technical staff to support their expertise and skills.

7. PROGRAMME MANAGEMENT

This document focuses on qualified individual to carry out the necessary curriculum monitoring and review of chemistry programme. To manage a programme requires good academic leadership. The programme leader should demonstrate knowledge, leadership skills and good values. The programme leader, i.e., Programme Coordinator, Head of Programme or equivalent position, must meet the qualification and experience requirements –

- Minimum a Master degree in related field AND
- Minimum of FIVE years of related academic and research experience; OR
- Minimum of FIVE years of related industrial experience.

8. PROGRAMME MONITORING, REVIEW AND CONTINUAL QUALITY IMPROVEMENT

Increasingly, society demands greater accountability from HEPs. Expectations are constantly changing as globalisation imposes more pressures on economic development, as science and innovations in technology create more opportunities for individuals and business corporations, and as knowledge generally becomes more easily and quickly available to the public at large. In facing these challenges, HEPs have to become dynamic learning organisations that need to systematically monitor the various issues so as to meet the demands of a constantly changing environment.

Quality is the responsibility of the HEP and it must have in place an effective and strong internal quality assurance mechanism to ensure and sustain a quality culture. Quality enhancement calls for programmes to be regularly monitored, reviewed and evaluated. These include the responsibility of the department to monitor, review and evaluate the structures and processes, curriculum components as well as student

progress, employability and performance. Feedback from multiple sources; students, alumni, academic staff, employers, professional bodies and informed citizens, assists in enhancing the quality of the programme.

The HEP should have a policy and associated procedures to assure the quality of their programmes. They should also commit themselves explicitly to the development of a culture that recognises the importance of quality, and quality assurance, in their work. The department is then expected to embrace the spirit of continual quality improvement based on prospective studies and analyses that leads to the revision of its current policies and practices, taking into consideration past experiences, present conditions, and future possibilities. (*COPPA 2nd* Edition, 2017).

Comprehensive monitoring and review of the programme for its improvement is to be carried out with a proper mechanism, considering feedback from various parties. The HEPs are expected to provide evidence of ability to keep pace with changes in the field and requirements of stakeholders. These may be demonstrated by, but not limited to:

1. curriculum review, conducted at least once every 3 - 5 years;
2. appointment of external reviewer for quality assessment processes;
3. linkages with industry;
4. continuous review of industrial/clinical attachment/ posting practices and records;
5. dialogue sessions with stakeholders at least once every 2 years;
6. active participation of academic staff at relevant conferences, seminars, workshops and short courses;
7. presentations by invited speakers, local or international; and
8. organisation of conferences, seminars and workshops.

REFERENCES

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APPENDIX 1

PROGRAMME STANDARDS DEVELOPMENT WORKING GROUP

Name	Organisation
Academician ChM Dr Ho Chee Cheong (Chairman)	Institut Kimia Malaysia
Datin ChM Dr Zuriati Zakaria	Institut Kimia Malaysia
ChM Dr Mansor Ahmad	Institut Kimia Malaysia
ChM Dr Yang Farina Abdul Aziz	Institut Kimia Malaysia
ChM Chang Hon Fong	Institut Kimia Malaysia
ChM Dr Malarvili Ramalingam	Jabatan Kimia Malaysia
Dato' ChM Dr Yew Chong Hooi	Institut Kimia Malaysia
Prof ChM Dr Teh Geok Bee	Institut Kimia Malaysia
ChM Dr Chong Fai Kait	Institut Kimia Malaysia
Prof ChM Dr Leong Loong Kong	Institut Kimia Malaysia
ChM Dr Aqeel Saravanan	Institut Kimia Malaysia
ChM Mohd Azizi Al-Hafiz Wirzal	Institut Kimia Malaysia
Assoc Prof ChM Dr Ooi Ing Hong	IMU University
ChM Dr Ng Thian Hong	HARPS Holdings Berhad
ChM Dr Chin Teen Teen	ALS Technichem (M) Sdn Bhd
Mr Kamarul Bakri Abd Aziz	Malaysian Qualifications Agency
Mrs Nor Hafizah Mohd Arip	Malaysian Qualifications Agency
Mrs Nur Atiqah Abdul Rahman	Malaysian Qualifications Agency

APPENDIX 2

LIST OF STAKEHOLDERS

A. Related Ministry, Agencies and Industry

1. Institut Kimia Malaysia
2. Jabatan Kimia Malaysia
3. Kementerian Pengajian Tinggi
4. Kementerian Sains, Teknologi dan Inovasi (MOSTI)
5. Jabatan Keselamatan dan Kesihatan Pekerjaan Malaysia
6. Jabatan Bomba Dan Penyelamat Malaysia
7. Malaysian Nuclear Agency
8. National Metrology Institute of Malaysia
9. Institut Penyelidikan Perhutanan Malaysia (FRIM)
10. Malaysian Rubber Board
11. Malaysian Palm Oil Board
12. PETRONAS Research Sdn Bhd
13. Sime Darby Plantation Berhad
14. ALS Technichem (M) Sdn Bhd
15. Synthomer (M) Sdn Bhd
16. American Chemical Society (ACS) Malaysian Chapter
17. Kossan Rubber Industries Bhd
18. MAPA Gloves Sdn. Bhd
19. HARPS Holdings Berhad

B. Higher Education Providers

1. Universiti Malaya
2. Univesiti Kebangsaan Malaysia
3. Universiti Sains Malaysia
4. Universiti Teknologi Malaysia
5. Universiti Putra Malaysia
6. Universiti Teknologi Petronas
7. International Islamic Universiti Malaysia
8. Universiti Malaysia Sabah

9. Universiti Sains Islam Malaysia
10. International Medical University
11. Tunku Abdul Rahman University of Management and Technology
12. UniKL MICET
13. Monash University Malaysia
14. Universiti Teknologi MARA
15. Universiti Malaysia Pahang
16. Universiti Malaysia Terengganu
17. Universiti Malaysia Sarawak

APPENDIX 3

COMPONENTS IN THE BODY OF KNOWLEDGE

NO	DISCIPLINE	BODY OF KNOWLEDGE
1.	**INORGANIC CHEMISTRY**	Atomic Structure and Periodicity Solid State Chemistry Molecular Structure and Bonding Main Group Elements (Group 1, 2, 13-18) Transition, Lanthanide and Actinide Elements Radioactivity Application of Inorganic Materials Organometallics
2.	**ORGANIC CHEMISTRY**	Basic Principles Chemistry of organic compounds Physical Organic Chemistry Stereochemistry Synthesis Experimental Techniques Industrial Chemistry
3.	**PHYSICAL CHEMISTRY**	Gaseous States The Solid State Thermodynamics Phase Equilibria Electrolytes and Electrochemistry Reaction Kinetics Surface Chemistry Quantum Chemistry and Molecular Spectroscopy
4.	**ANALYTICAL CHEMISTRY**	Basic Principles Separation Process Instrumental Analysis Experimental
5.	**CHEMICAL SAFETY**	Introduction to Occupational Health, Safety and Environment Management System; Chemical Industry & Management System; Health, Physical and Environmental Hazards; Classification and Labelling of Chemicals; Safety Data Sheets; Managing, Handling and Disposing of Chemicals & Waste

Note: HEPs can use the body of knowledge contents above to develop the topics.

APPENDIX 4

PROGRAMME NOMENCLATURE

The programmes in the field of chemistry may be offered as indicated below, but not limited to:

Programme Structure	Explanation	Example
Major	A programme containing only one main area.	Bachelor of Science in Chemistry with Honours Bachelor of Science (Honours) in Chemistry Bachelor of Science (Honours) Applied Chemistry
Major - Minor	A programme with a **minor** that includes 25-30%* of the body of knowledge **in another discipline**. The conjunction **'with'** is used in naming this type of programme where the major and minor disciplines are mentioned.	Bachelor of Science in Chemistry with Management (Honours) Bachelor of Science in Chemistry with Entrepreneurship (Honours) Bachelor of Science in Chemistry with Education (Honours)

Note: Refer to the Policy on Nomenclature of Malaysian Higher Education Programme for further reference.