KURIKULUM PROGRAM STUDI

Program Studi
Program Doktor Pendidikan Kimia
FMIPA UNY
2022

Fakultas Matematika dan Ilmu Pengetahuan Alam
Universitas Negeri Yogyakarta
2022

CURRICULUM

PROGRAM STUDY

DOCTORAL (S-3) CHEMISTRY EDUCATION

2022

DOCTORAL OF CHEMISTRY EDUCATION CURRICULUM
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS NEGERI YOGYAKARTA
YEAR OF 2022

I. VISION DAN MISSION

A. Scientific Vision

"The development of Pedagogical Content Knowledge (PCK) is supported by digital competencies oriented towards Green Chemistry and Responsible Citizen to increase global competitiveness." The meaning of the vision can be explained as follows:

1. Pedagogical Content Knowledge (PCK) means that the Chemistry Education Doctoral Program is committed to developing specific pedagogical knowledge and practices to teach chemistry appropriately through published research so that it has an impact on efforts to improve the quality of chemistry education to answer the challenges of the 21st century.
2. Digital Competence is interpreted as an effort to accommodate the development of globalization and the 4.0 industrial revolution, so the Chemistry Education Doctoral Program is committed to producing research in the field of chemical education that is ready to answer today's challenges.
3. Green Chemistry means that the research developed by the Chemistry Education Doctoral Program is always aimed at utilizing environmentally friendly natural resources to support educational programs for sustainable development.
4. Responsible Citizen means that learning and research in Chemistry Education Doctoral Program strengthens the relevance of chemistry learning, especially in the vocational/professional dimension that supports the concept of science for all in realizing responsible citizens to answer the challenges of the revolution of society 5.0.
5. Global Competitiveness means that research in Chemistry Education Doctoral Program is directed at the latest research trends and paradigms that are developing in the international world, supported by optimizing local wisdom so that they can play a role in improving the quality of chemistry education in a global context.

B. Mission

1. Organizing education at the level of Strata-3 (S-3) with chemical education expertise that develops competencies in students about pedagogics, social and professional personalities who are reliable at the global level, and have competence in the world of work.
2. Take an active role in developing chemistry education related to theory and practice and research in content knowledge and pedagogy (curriculum, evaluations, learning media, and learning technology).

3. Take an active role in the development of essential competencies in the field of chemistry education based on seven basic categories of competence for professional teachers: subject matter content knowledge, pedagogical content knowledge (PCK), curriculum knowledge, general knowledge of learners, pedagogical knowledge, knowledge of educational contexts and understanding of educational ends.
4. Develop scientific concept communication skills by writing in the form of national and international scientific articles and presenting the results of studies or research to the national and international community.
5. Develop original research that can trigger new knowledge about chemistry education.
6. Cooperating with institutions at home and abroad based on quality to support institutional development.
7. Play an active role in applying chemistry education in the community.

II. Profil of Graduate

Graduates from the Doctoral Program (S-3) Chemistry Education are Doctors who are expected to work in general in the field of science education and specifically in the field of chemistry education.

No.	Profil of Graduate	Profile Description
1	Educators in Higher Education and High School in Chemistry Education	Doctoral of Chemistry Education who: - able to master general concepts and principles in the whole field of chemistry and in-depth in the field of chemistry, which includes structure and bonding, dynamics, energetics, and measurement. - able to design, implement, evaluate and develop chemistry learning in secondary schools and universities with a character-oriented education. - master the basic concepts and principles of pedagogy and innovative chemistry learning methodologies. - able to solve chemistry learning problems through interdisciplinary, multidisciplinary, or transdisciplinary approaches.
2	Chemical Education Researcher	Chemical education researcher who: - mastering educational research methods for innovation and improvisation of chemistry learning.

		- able to solve chemistry learning problems through a multidisciplinary approach. - have the ability to research and develop techniques and methods of teaching chemistry so that learning chemistry will be easy and fun.
3	Chemical Education Consultant	Chemical education consultant who: - have responsibility for learning chemistry at school independently and can be given responsibility for the achievement of the work of an institution or organization by prioritizing the development of potential and character building of students. - have a leadership spirit and be able to apply management principles to manage education - has responsibility for managing parts of the chemical education process or in preparing, handling, and managing chemicals in government and private institutions' environmental and manufacturing processes.
4	Chemical Education Analyst and Engineer	Chemical education analyst and engineer who: - Ability to analyze education management policies, curriculum, evaluations, and teaching technology related to chemistry learning. - has responsibility for managing parts of the chemical education process or in preparing, handling, and managing chemicals in government and private institutions' environmental and manufacturing processes.

III. Learning Outcomes

The Doctoral Program (S-3) has a level 9 qualification based on the KKNI. Parameter description and learning outcomes (Doctoral Program (S-3) Chemistry Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta:

PARAMETER DESCRIPTION	LEARNING OUTCOME
ATTITUDE AND VALUES	1. Be devoted to God Almighty and have good morals, ethics, and personality in completing their duties. 2. To act as proud citizens who love their homeland and support world peace.

	3. Ability to work together, have high social sensitivity and concern for society and the environment, and appreciate the diversity of cultures, views, beliefs, religions, and other people's original opinions/findings. 4. Uphold law enforcement and have the spirit of putting the nation's and society's interests first. 5. Able to internalize correct academic values and norms related to honesty, ethics, attribution, copyright, confidentiality, and data ownership. 6. Able to internalize the entrepreneurial spirit
SPECIAL ABILITY (Able to develop knowledge, technology, and or art in the field of science or professional practice through research, to produce innovative and tested works).	1. Apply and develop knowledge and technology in the field of chemistry education through reasoning and scientific research based on logical, critical, systematic, and creative thinking. 2. Develop chemistry education through scientific research, or produce scientific works and study concepts based on scientific principles compiled in the form of a dissertation. 3. Publish the results of research in the field of chemistry education in reputable international scientific journals and proceedings. 4. Increase the capacity for independent learning. 5. Have structured learning skills for self-development, scholarship, and career sustainability. 6. Able to think critically, make appropriate decisions, and communicate effectively, academically, and ethically.
KNOWLEDGE (Able to solve problems of science, technology, and or art in the field of science through an inter or multidisciplinary approach).	1. Documenting, managing, storing, auditing, and securing data on research results in the field of chemistry education for different research purposes under his responsibility. 2. Able to compile chemical education research, with an interdisciplinary, multidisciplinary, or transdisciplinary approach, including theoretical studies and experiments in the fields of science, technology, art, and innovation as outlined in the form of dissertations, and papers published in reputable international journals. 3. Carry out chemical education research based on research maps with an interdisciplinary, multidisciplinary, or transdisciplinary approach

	independently or in collaboration with other institutions. 4. Able to choose research in the field of chemical education that is appropriate, current, advanced, and provides benefits to humanity through an interdisciplinary, multidisciplinary, or transdisciplinary approach, to develop and produce problem-solving in the fields of science, technology, and society, based on the results of the study regarding the availability of internal and external resources. 5. Able to develop a research roadmap in chemistry education with an interdisciplinary, multidisciplinary, or transdisciplinary approach, based on a study of the leading research objectives and their constellation on a broader target.
GENERAL ABILITY (Able to manage research and development that benefits society and science and can gain national and international recognition).	1. Develop and maintain a network with colleagues, peers within the institution, and the research community in the broader field of chemistry education (outside the institution). 2. Able to formulate scientific, technological, or artistic arguments and solutions in chemistry education based on a critical view of facts, concepts, principles, or theories that can be accounted for scientifically and academically and communicate them through the mass media or directly to the public. 3. Able to demonstrate academic leadership in managing the development and development of resources and organizations under their responsibility.

IV. Study Material

No.	Study Material	Subjects
1	*Pedagogical Content Knowledge*	- Philosophy of Science and Technology Education - Review of Organic Chemistry and its Learning - Review of Inorganic Chemistry and Its Learning - Analytical Chemistry Review and Its Learning - Review of Physical Chemistry and its Learning - Review of Biochemistry and its Learning - Chemistry Experiments in Chemistry Learning
2	*Pedagogical Knowledge*	- Dissertation

		- Writing Journal Articles - Writing Dissertation Proposal - Chemistry Education Research Methodology - Dissertation Proposal Seminar - Curriculum Innovation in Chemistry - Theories and Applications: Information Technology in Chemistry Learning - Planning, Organizing and Evaluating Chemical Learning - Issues and Trends in Chemical Education Research - Design and Data Analysis of Chemical Education Research - Development of Chemistry Learning Strategies - Qualitative Research Methodology
3	*Content Knowledge*	- Models and Visualization in Chemistry - Chemistry in Modern Life - Nanochemistry - Special Topics in Inorganic Chemistry and Physical Chemistry - Special Topics in Organic Chemistry and Biochemistry

V. Curriculum Structure and Distribution of Course

A. Curriculum Structure

No.	Subjects	Credits	Amount	Information
1	Scientific Foundation	4	**4**	Expertise Foundation Course
2	Study Program Expertise: a. Chemistry Education	32	**46**	Expertise Course
	b. Chemistry	10		
	c. Choice	4		Choose four credits of elective courses from the 18 credits of courses provided
3	Matriculation	6	**6**	1. Mandatory for students who come from non-educational masters

				2. Not included in the transcript of S-3 graduation scores

B. Distribution of Chemistry Education S-3 Study Program Curriculum Courses

No.	Code	Subjects	Amount	T	P	L	Semesters and Credits						Amount
							1	2	3	4	5	6	
I.	**Scientific Foundation Course**												
1	FMI9201	Philosophy of Science and Technology Education	2	√			2						**4**
2	FMI9202	Multivariate Statistics	2	√				2					
II.	**Expertise Course : Chemistry Education Study Program**												
3	MPK9310	Writing Dissertation Proposal	3	√	√			3					**32**
4	MPK9311	Dissertation Proposal Seminar	2		√				2				
5	MPK9912	Dissertation	9		√							9	
6	MPK9313	Writing Journal Articles	3	√	√				3				
7	MPK9301	Curriculum Innovation in Chemistry	3	√				3					
8	MPK9302	Theories and Applications: Information Technology in Chemistry Learning	3	√	√				3				
9	MPK9303	Planning, Organizing and Evaluating Chemical Learning	3	√				3					
10	MPK9323	Chemistry Education Research Methodology	3	√			3						
11	MPK9204	Issues and Trends in Chemical Education Research	2	√			2						
III.	**Study Program Expertise Course : Chemistry *(Subject Matter)***												
12	MPK9205	Models and Visualization in Chemistry	2	√			2						**10**
13	MPK9206	Chemistry in Modern Life	2	√			2						
14	MPK9207	Nanochemistry	2	√				2					
15	MPK9208	Special Topics in Inorganic Chemistry and Physical Chemistry	2	√			2						

16	MPK9209	Special Topics in Organic Chemistry and Biochemistry	2	√			2						
IV.	**Elective Courses (4 credits out of 18 credits)**													
17	MPK9214	Design and Data Analysis of Chemical Education Research	2	√				2						**4**
18	MPK9215	Development of Chemistry Learning Strategies	2	√				2						
19	MPK9216	Qualitative Research Methodology	2	√				2						
20	MPK9217	Chemistry Experiments in Chemistry Learning	2	√				2						
21	MPK9218	Review of Organic Chemistry and its Learning	2	√				2						
22	MPK9219	Review of Inorganic Chemistry and Its Learning	2	√				2						
23	MPK9220	Analytical Chemistry Review and Its Learning	2	√				2						
24	MPK9221	Review of Physical Chemistry and its Learning	2	√				2						
25	MPK9222	Review of Biochemistry and its Learning	2	√				2						
Number of Credits														**50**
V.	**Matriculation Course***													
1	Activity 1	Innovation in Chemistry Learning	2	√				2						**6**
2	Activity 2	Design and Implementation of Chemistry Curriculum	2	√			2							
3	Activity 3	Development of Assessment and Evaluation in Chemistry Education	2	√				2						

Information:

- Elective courses are taken = 4 credits of the 18 credits of courses provided.
- *Matriculation courses are held during the semester between.

VI. Course Description

A. Scientific Foundation Course

1. Philosophy of Science and Technology Education *(*FMI920)

   This course is presented so that students gain knowledge about the nature of scientific thinking processes and means, which include ontological, epistemological, and axiological characteristics of science, the advantages, and disadvantages of science, the nature of scientific methods and scientific research methods, the nature of language, logic, education as a science, ethics science and the role of chemistry and technology in the development of human civilization.

2. Multivariate Statistics (FMI9202)

   This course is presented so that students can apply the necessary statistical methods related to their scientific field and use statistics as a tool in carrying out research, especially in writing a thesis. This course discusses the use of statistical methods in quantitative analysis applied in the chemistry education field. The subject matter of this course includes simple linear regression analysis and simple correlation analysis, multiple linear regression analysis and various correlations, concepts, and aspects of multivariate analysis, multivariate and random vector analysis, multivariate vector analysis, multivariate analysis variance, assumptions in multivariate analysis of variance, multivariate covariance analysis, and beliefs in multivariate covariance analysis. This material is prioritized for mastery of concepts in quantitative analysis using statistical methods. In addition, as a supporter, the application of software usage, which is generally used in statistical analysis, is also discussed..

B. Scientific Course: Chemistry Education

3. Writing Dissertation Proposal (MPK9310)

   This course is a course that facilitates students to be able to prepare a dissertation proposal with good quality, planned and systematic, to accelerate the research process for their dissertation. Students are expected to be able to write well about the background of the problem, problem identification, problem formulation, research benefits, a framework of thinking, research hypotheses, and research method plans.

4. Dissertation Proposal Seminar (MPK9311)

   In this course, students present and have structured discussions to discuss dissertation proposals with course supervisors and supervisors, which include: background problems, problem identification, problem formulation, research benefits, a framework of thinking, research hypotheses, research method plans, and writing formats.

5. Dissertation (MPK9912)

   This course is intended to carry out independent research, write, present, and be tested (defended) in front of the board of examiners on the student's separate research report (dissertation), which the supervisor has approved.

6. Writing Journal Articles (MPK9313)

   This course is intended to provide experience in expressing ideas through articles published in reputable international journals. The final result of this course is that an article is produced with student authors and dissertation supervisors, ready to be submitted in international journals.

7. Curriculum Innovation in Chemistry (MPK9301)

   This course is presented so that students understand the existence of various curriculum theories and their application in schools and universities in general and specifically in learning chemistry. This course is also presented to equip students in developing different kinds of high school and college chemistry curricula related to chemistry learning. This course is offered so that students understand the theory of planning and developing a chemistry curriculum at the school (SMA), university (PT), subject, and subject levels. Therefore, the topics of this course relate to, among others, the basics of planning and developing a chemistry curriculum, the function of teachers and lecturers in planning and developing a chemistry curriculum, developing chemistry curriculum objectives, developing chemistry curriculum materials, developing chemistry curriculum methods, and evaluating chemistry curriculum and the completeness of curriculum tools.

8. Theories and Applications: Information Technology in Chemistry Learning (MPK9302)

   This course is presented so that students understand the theory and practice of information technology-based learning media to make it easier to understand chemistry.

9. Planning, Organizing and Evaluating Chemical Learning (MPK9303)

   This course aims to make students understand and develop measurement and evaluation techniques for chemistry learning, preparation of chemistry learning outcomes tests, and analysis of chemistry learning outcomes tests at an advanced level.

10. Chemistry Education Research Methodology (MPK9323)

    This course intends to provide students with an overview of research methodologies and design studies, specifically in chemical education research with quantitative and qualitative approaches. Through this course, students are expected to master the basic concepts of educational research, including finding, identifying, analyzing problems, determining the types of variables and hypotheses, differentiating various sampling techniques, and developing educational research instruments and data analysis techniques well. In addition, students are also expected to be able to study the types of research (descriptive, experimental, quasi-experimental, pre-experimental, correlational, comparative, developmental, survey, phenomenology, and action research) comprehensively on the characteristics of the problem, variables, and sampling techniques, types of research design, determination of instruments, and data analysis techniques. The topics discussed were related to the logical basis of scientific research, quantitative and qualitative research types, theoretical studies that underlie them, research variables and hypotheses, research design, sampling techniques, population, data analysis instruments and techniques, and interpretation of results and discussion. This is

directed so that students can prepare a research design/proposal, conduct research, and compile a report on the results as a final project (Dissertation).

11. Issues and Trends in Chemical Education Research (MPK9204)

    This course is presented so that students can explain various issues and the latest chemistry education research, especially those related to problems in chemistry learning and how to overcome them related to aspects of student input, instrumental input, environmental input, and elements of the chemistry learning process. Various chemistry research topics included the nature of chemistry learning, models, student and ecological input problems, teacher-instrumental input problems, chemistry learning methods, media, materials, learning problems, and chemistry teaching evaluation.

C. Scientific Course: Chemistry

12. Model and Visualization in Chemistry (MPK9205)

    This course is presented so that students can understand the existence of various models for developing science process skills and different models using multiple media to facilitate understanding chemistry. This course is also presented so that students can understand the theory, principles, and visualization concepts and their application in chemistry.

13. Chemistry in Modern Era Life (MP9206)

    The course discusses the role of chemistry in developing science and technology to play a role in human life. They are predicting the future outcome of chemistry in the fields of organic chemistry, biochemistry, physical chemistry, inorganic chemistry, and analytical chemistry.

14. Nanochemistry (MPK9207)

    The course discusses the concepts and principles of nanochemistry, the application of nanochemistry in everyday life, the synthesis and characterization of nanoparticles, and the development of particles for human life.

15. Special Topics in Inorganic Chemistry and Physical Chemistry (MPK9208)

    This course is in the form of interactive lecturer-student activities with critical topics through a scientific approach to selected topics in inorganic chemistry, analytical chemistry, and physical chemistry based on the latest research and literature.

16. Special Topics in Organic Chemistry and Biochemistry (MPK9209)

    This course is in the form of interactive lecturer-student activities with critical topics through a scientific approach to selected topics in organic chemistry, analytical chemistry, and biochemistry based on research and the latest literature.

D. Elective Courses: Chemistry Education and Chemistry

17. Design and Data Analysis of Chemical Education Research (MPK9214)
    This course is intended so that students can learn more about the types of research (descriptive, experimental, quasi-experimental, pre-experimental, correlational, comparative, developmental, survey, phenomenology, and action research) comprehensively on the characteristics of the problem, variables, and decision-making techniques, sample, type of research design, determination of instruments, and data analysis techniques. This is directed so that students can develop a final research design (Dissertation) and analyze research data based on the type of research design.

18. Development of Chemistry Learning Strategies (MPK9215)
    This course is presented so students can understand and develop chemistry learning strategies with various models and techniques for developing science process skills and different models using multiple media to provide convenience in learning chemistry.

19. Qualitative Research Methodology (MPK9216)
    This course is presented so that students can understand the theories, principles, and concepts of qualitative research methodologies as well as qualitative assessments and their application in the learning process of chemistry..

20. Chemical Experiments in Chemical Learning (MPK9217)
    In this course, Students are expected to master the basic concepts and techniques of chemical experiments that can be used for student and student learning.

21. Review of Organic Chemistry and Its Learning (MPK9218)
    This course discusses special topics or topics of choice in organic chemistry for materials in high school and college and the development of techniques, methods, and methods of presentation or disclosure for students and students.

22. Review of Inorganic Chemistry and Its Learning (MPK9219)
    This course discusses specific topics or elective topics in inorganic chemistry for high school and college materials and the development of techniques, methods, and methods of presentation or disclosure for students and students.

23. Review of Analytical Chemistry and Its Learning (MPK9220)
    This course discusses specific topics or topics of choice in analytical chemistry for high school and college materials and the development of techniques, methods, and methods of presentation or disclosure for students and university students.

24. Review of Physical Chemistry and Its Learning (MPK9221)
    This course discusses specific topics or topics of choice in physical chemistry for materials in high school and college (PT) and the development of techniques, methods, and methods of presentation or disclosure for students and students.

25. Review of Biochemistry and Its Learning (MPK9222)

This course discusses specific topics or topics of choice in biochemistry for materials in high school and college (PT) and the development of techniques, methods, and methods of presentation or disclosure for students and students.

E. Matriculation Courses

1. Innovation in Chemistry Learning (Activity 1)
   This course is presented so that students understand the existence of various modern learning theories and their application in schools and universities in general and specifically in learning Chemistry. This course is also presented to equip students to develop different kinds of learning strategies in general, particularly the chemistry learning process.
2. Design and Implementation of Chemistry Curriculum (Activity 2)
   This course is presented so that students understand the theory of planning and developing a chemistry curriculum at the school and university level, subject level, and subject level. Therefore, the topics of this course relate to, among others, the basics of planning and developing a chemistry curriculum, the function of teachers and lecturers in planning and developing a chemistry curriculum, developing chemistry curriculum objectives, developing chemistry curriculum materials, developing chemistry curriculum methods, and evaluating chemistry curriculum and the completeness of the curriculum.
3. Development of Assessment and Evaluation in Chemistry Education (Activity 3)
   This course aims to make students understand and develop techniques for measuring and evaluating chemistry learning, preparing chemistry learning outcomes tests, and analyzing chemistry learning outcomes tests at an advanced level.

VII. Learning Process

All S-3 Chemistry Education Study Program students must attend face-to-face lectures held at the Postgraduate Program Building, Universitas Negeri Yogyakarta. The number of meetings in learning is 16 meetings. Based on the academic regulations of the Postgraduate Program, it is confirmed that the course exam requirements are only allowed for students who can attend lectures at least 75%. Students whose attendance is less than 75% must repeat the following year or meet the lack of meetings by the lecturer concerned. In connection with this, students will experience difficulties living outside the area; therefore, they must live not far from the Karangmalang campus, Universitas Negeri Yogyakarta.

Face-to-face lectures are held in the lecture hall at the Postgraduate Program Building, Universitas Negeri Yogyakarta, from Monday-Friday. The Chemistry Education S-3 Study Program organizes lectures supported by special assignments. Lectures are conducted face-to-face with a time allocation of 50 minutes/credit, structured learning assignments of 60 minutes/credit, and self-study assignments of 60 minutes/credit. Face-to-face lectures are carried out using various methods, including lectures, questions, answers, case discussions, case presentations, book reviews, writing papers, and articles from international journals (in English). Following the academic rules in the Chemistry Education Doctoral Program, students

can take dissertation courses if students have taken all theoretical approaches with a minimum GPA of 3.0.

VIII. Evaluation

Assessment of courses carried out by lecturers can be through assignments, midterm exams, final semester exams, practical exams, and dissertation exams. The weighting for each assessment component is determined by the lecturer in charge of the course. Course exams produce scores that symbolize students' ability to achieve course learning objectives. The results of the mid-semester exam determine students' final grades, final semester exams, individual or group assignments, or a chemistry research project in a chemistry laboratory.