SUMMARY OF CURRICULUM

Undergraduate Programme in Chemistry Education

Ecopreneurship
Growing with character

Undergraduate Programme in Chemistry Education
Faculty of Mathematics and Natural Sciences
Universitas Negeri Surabaya
2020

Lembar Pengesahan

Summary Curiculum **Program Studi S1 Pendidikan Kimia** telah didiskusikan dan disetujui dalam Rapat Fakultas yang dihadiri oleh Senat Fakultas, Dekanat, Kaprodi, dan Tim Kurikulum FMIPA Unesa.

Surabaya, 22 Juli 2019

Dekan FMIPA

Prof. Dr. Madlazim

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A. OBJECTIVES OF THE DEGREE PROGRAM

Vision and Mission of Institution

Vision of Universitas Negeri Surabaya (Unesa):

Excellent in Education, Strong in Science

Missions of Universitas Negeri Surabaya (Unesa):

1. To conduct education and learning centered on students by using effective instructional approaches, and optimizing the use of technology
2. To conduct researches in educational sciences, natural sciences, social and cultural sciences, arts, and/or sports, and developments of technologies whose findings are beneficial for the development of sciences and public welfares
3. To disseminate science, technology, arts, culture and sports, and research results through community service oriented towards empowering and civilizing society
4. To realize Unesa an educational center, especially for primary and secondary educations as well as a scientific center based on the noble values of national culture
5. To conduct an autonomous, accountable, and transparent high educational governance for a sustainable quality assurance and improvement.

Vision and Mission of Faculty

Vision of Faculty of Mathematics and Natural Science (FMNS):

Excellent* in Education on Mathematics and Natural Science, Strong* in Mathematics and Natural Science Studies in 2035

Extended Vision of FMNS:

1. Excellent in innovation of mathematics and natural science education.
2. Strong in mathematics and natural science studies and their applications for strengthening mathematics and natural science education (wider mandate).
3. Excellent in global competition.
4. Excellent in graduates having environmental-minded and entrepreneurial spirit.

* “excellent” means to be innovative, competitive, and always trying to improve quality. “strong” means to work systematically, methodically, and objectively, to support the excellence of the studies in mathematics and natural sciences.

Missions of Faculty of Mathematics and Natural Science (FMNS):

1. To conduct innovative and research-based mathematics and natural science education to produce graduates who are environmentally minded, entrepreneurial in spirit and have global competitiveness.
2. To conduct researches on mathematics and natural sciences to strengthen both the studies being recognized nationally and internationally and mathematics and natural science education.
3. To conduct research-based community services to support community welfare.
4. To build a strong network of collaborations with stakeholders to improve the quality and image of FMNS.
5. To conduct an autonomous, credible, fair, accountable, and transparent governance for quality assurance and quality improvement in FMNS.

Objectives of Faculty of Mathematics and Natural Science (FMNS):

1. Produces graduates in mathematics and natural sciences and education having environmental insight, entrepreneurial spirit, and global competitiveness.
2. Yields research results in mathematics and natural sciences and education to strengthen the studies of MNS and MNS education.
3. Implements research results for community services to support community welfare.
4. Executes strong collaboration with stakeholders to improve the quality and image of FMIPA.
5. Realizes a governance system in FMNS that is autonomous, credible, fair, accountable, and transparent for quality assurance and quality improvement.

Vision and Missions of Study Program

The Vision of Undergraduate Program of Education Chemistry (UPCE) :

Becomes an excellent, competitive, and becomes a reference for the other chemistry learning institution at national level in the development of science and human resources in the field of chemistry education with an environmental insight

The Missions of Undergraduate Program of Education Chemistry (UPCE)

1. Conducting academic education in the field of research-based chemistry education and global competencies with environmental insight.
2. Carry out innovative research and development in the field of chemistry education.

3. Dedicating expertise in the field of chemistry education to empower the community.
4. Building a cooperation network with various institutions or agencies and stakeholders for the sustainability of study programs.
5. Realize a credible, transparent, accountable, responsible and fair governance of study program governance.

B. PROGRAM EDUCATIONAL OBJECTIVES (PEO)

To produce graduates with qualifications according to Table 1, the UPCE prepares a Program Education Objectives (PEO). PEO is the result of joint discussions and thoughts from the drafting team after reviewing a number of relevant documents and input from stakeholders. The PEO is structured to face the global challenges of graduates of Chemistry Education in the form of demands for the development and development of science and technology in the industry 4.0 era. Each PEO is expected to be understood and implemented by every chemistry graduate from Chemistry Department, FMIPA UNESA in teaching chemistry to their students, both in using ITE and in higher-order thinking. It is hoped that PEOs graduates of chemistry education will be able to become role models for especially the school community and the general public.

The Bachelor of Education in Chemistry (BEC) at the Faculty of Mathematics and Natural Sciences (FMNS), Universitas Negeri Surabaya (UNESA) is objected in order to prepare as teachers, managers of educational institutions, researchers, and entrepreneurs in national and global development with a title of Bachelor of Chemistry Education (S.Pd), who have:

PEO-01: Mastering in the concepts of chemistry, chemistry learning, laboratory management, scientific methods and ICT and is able to apply them to problem solving in their work.

PEO-02: A high-level thinking ability to communicate ideas verbally and in writing, ability to take the right initiatives and decisions, and lead working groups in relevant fields.

PEO-03: Ability to collaborate, be honest, and be responsible for work in the field of expertise and entrepreneurship in the field of education that is environmentally friendly (green-edupreneurship).

PEO-04: Capability to continue to develop and lifelong learning to continue education, both formal and informal

PEO-05: Ability to develop and apply chemical competencies along with advances in science and technology and humanities values

The graduate profile and qualification of the Bachelor of Education in Chemistry, FMIPA UNESA was developed based on the National Standards for Higher Education (SN DIKTI) 2014, through the Grant for Program Learning Outcomes (PLO) from the Directorate of Learning and Student Affairs (the Directorate General of Higher Education, the Ministry of Research, Technology, and Higher Education) dated *Self Assessment Report for ASIIN Accreditation* December 31, 2016. The development activities started with PLO Workshop based on the Indonesian National Qualifications Framework (KKNI) and Outcome-Based Education (OBE), involving the management of the BEC, the management of PPG and Master of Education in Chemistry at FMIPA UNESA, students, education personnel, alumni, the results of treasure study, the report of School Field Program and users (schools). The implementation of OBE in the BEC UNESA is based on a circular letter of BAN-PT (National Accreditation Board for Higher Education) Number 4/2017 concerning accreditation instrument, outcome-based accreditation system (***link 1.2***). What is meant by outcome-based accreditation is, study program accreditation (APS) shall focus on the achievement of graduates' learning outcomes, while university accreditation (APT) shall focus on the achievement of university's visions, missions, and objectives.

C. PROGRAM LEARNING OUTCOMES (PLO)

The process of PLO formulation has considered input provided by stakeholders both internal and external stakeholders. Internal stakeholders consist of academic staf /lecturers and students, while external stakeholders consist of alumni, the Department of Education and the Indonesian Chemical Association (HKI) in the field of education. Stakeholder input on graduate profile based on scientific analysis and development skills, analysis of market needs and decision makers endorsed by Presidential Regulation Number 12 of 2012 concerning Higher Education, Presidential Regulation Number 8 of 2012 concerning the Indonesian National Qualification Framework (KKNI), Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers. Minister of Higher Education and Technology

Regulation No. 44 of 2015 concerning National Standards for Higher Education (SNPT). The results which are manifested in the form of PLOs, have been formulated as follows:

PLO-1 Mastering chemical content both theoretical concepts about structure, dynamics, and energy, as well as the basic principles of separation, analysis, synthesis and characterization of chemicals.

PLO-2 Mastering pedagogical knowledge of chemistry and applying it in designing, implementing, and evaluating learning.

PLO-3 Mastering laboratory management based on the principles of Occupational Safety and Security (K3), managing the laboratory and using its equipment and how to operate chemical instruments.

PLO-4 Being able to develop chemistry learning media by utilizing Information and Communication Technology (ICT).

PLO-5 Applying the logical thinking, high-level thinking, critical, systematic and innovative in the context of the development or implementation of science, technology, and art that pays attention to and applies humanities in accordance with the field of chemistry education in solving problems.

PLO-6 Mastering the basics of the scientific method, designing and carrying out research based on chemistry education, compiling scientific reports and communicating them both verbally and in writing by utilizing information and communication technology (ICT).

PLO-7 Building cooperation and having entrepreneurial skills that are environmentally sound.

PLO-8 Being able to adapt to various developments in chemistry, continuing to develop and learning throughout life to continue education, both formal and informal.

Regarding to the aspects of connection between PLO and PEO, Table 2 gives an overview how strong each of PLOs supports the PEO.

Table 2. Correlation between Objectives and the Program Learning Outcomes of UPCE

	PEO 01	PEO 02	PEO 03	PEO 04	PEO 05
PLO-1	S	NS	NS	NS	S
PLO-2	S	NS	NS	NS	S
PLO-3	S	NS	NS	NS	S
PLO -4	NS	S	NS	NS	S
PLO -5	NS	S	NS	NS	S
PLO -6	S	S	NS	NS	NS
PLO -7	NS	NS	S	NS	S
PLO -8	NS	NS	NS	S	S

S-Strong, NS-Not Strong

Tabel 3. Program Learning Outcome (PLO) vs the 6th level (the level for bachelor education) of the Indonesian National Qualification Framework (INQF)

PLO vs INQF	Capable of apply science, technology, and art within his/her e√pertise and adaptable to various situations faced during solving a problem	Mastering in-depth general and specific theoretical concepts of certain knowledge and capable of formulating problem-solving procedure	Capable of taking strategic decision based on information and data analysis as well as providing direction in choosing several alternative solutions	Responsible for his/her own jobs and can be assigned to take responsibility of the attainment of organization's performances
PLO-1		√		
PLO-2	√			
PLO-3	√			
PLO-4	√			
PLO-5	√			
PLO-6		√		
PLO-7			√	
PLO-8				√

Based on Table 3, the PLO has been formulated in accordance with the level 6 minimum competency standards possessed by undergraduate. All PLO that have been formulated are accommodated in courses. At the end of each semester, an evaluation of the achievement of PLO is carried out and analyzed. The results of the analysis are used for further development of the PLO.

Table 1. Program Learning Outcome (PLO) vs Subject Specific Criteria (SSC) ASIIN

Subject Specific Criteria (**SSC**)	**PLO**							
	1	2	3	4	5	6	7	8
Specialist competences								
1. have gained chemistry-relevant **fundamental knowledge of mathematics and the natural sciences**,	√							
2. have sound knowledge of the **core subjects of chemistry** including inorganic, organic and physical chemistry, as well as of analytical chemistry,	√							
3. have gained knowledge in one or several other **special areas** in the natural sciences or humanities,					√			
4. are able to carry out **practical chemistry work** and have learnt how to handle chemicals independently and safely in lab practicals,			√					
5. have knowledge of **safety and environmental issues** and the legal fundamentals,			√					
6. have gained methodological competence in chemistry and are able to apply this in other conte√ts, and						√		
7. have interdisciplinary knowledge and skills, such as in economics, ethics or philosophy.							√	
8. obtain, interpret and evaluate data of scientific and technical relevance, and to draw sound conclusions, which take into account scientific, technological and ethical findings,						√		
9. solve problems of a scientific/application-oriented nature independently, and to present the results, as well as						√		
10. pursue lifelong learning.								√
Social competences								
11. are able to **communicate** with colleagues working in the field as well as with the broader public, about chemistry-related contents and problems, also in a foreign language and on an intercultural basis,		√						
12. are aware of social and ethical **responsibility** in their actions and are familiar with the professional ethical principles and standards of chemistry,				√				
13. are able to work both alone and as a member of international, mi√ed-gender **groups**,							√	
14. are familiar with the basic principles for conduction of **projects** and able to **develop**				√				

Based on Tables 2, 3, and 4 the qualifications obtained by graduates allow them to work in the fields they have planned, according to the graduate profile.

D. PROGRAM STRUCTURE

1. The Curriculum

The undergraduate program in UPCE FMNS Universitas Negeri Surabaya has a degree of Bachelor of Education (Sarjana Pendidikan or S.Pd.). In addition to being based on input from stakeholders, the improvement of the UPCE curriculum structure is also the result of an evaluation of the current conditions and future needs of the profession in chemical education, taking into account national and global challenges as summarized in Figure 1. By accommodating challenges Accordingly, the structure and syllabus of the course have been revised and applied in the period 2013 - 2018. Evaluations of ongoing implementation are carried out every year.

The UPCE curriculum is delivered in 4 years through 3 main structures: basic knowledge, expertise knowledge and synthesis, as illustrated in Figure 2. In this structure, the learning process to gain competency is modeled in the course flow. Basic knowledge is the foundation of the program, knowledge groups as pillars, and the synthesis of knowledge as a roof that includes all knowledge in the field of chemical education.

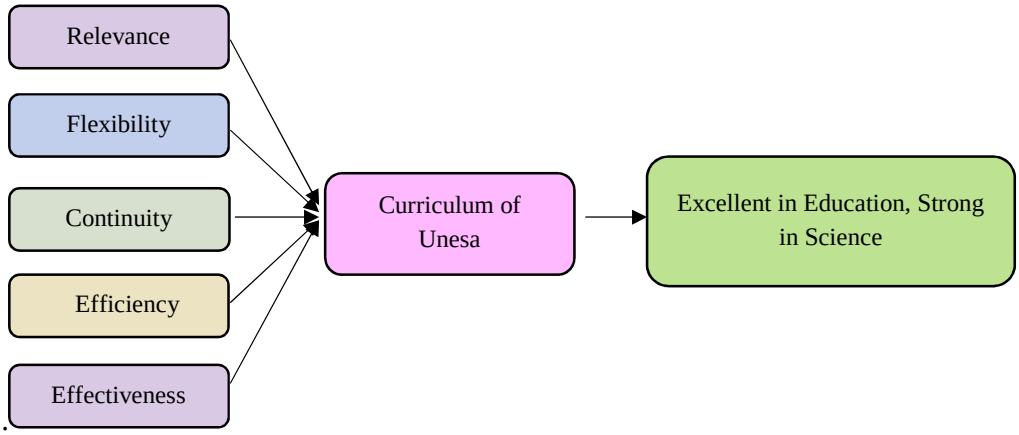

Figure 1. Principles of curriculum development

The minimum workload of Undergraduate Program at Unesa is 144 credit units (CU) which correspond to 6,048 hours 1 or 201.6 ECTS, and are generally distributed in 8 regular semesters. On average, the total hour per year is 756 hours. The normal workload for each regular semester is limited to 840 hours, corresponds to 20 CU (28 ECTS). The normal workload for each short semester is limited to 420 hours, corresponds to 10 credit unit (14 ECTS).

Table 5. Compulsory and elective courses in UPCE

CU Compulsory courses	CU	ECTS	Note
CU of compulsory courses	**133**	**211.47**	The CU courses are distributed into 49 compulsory courses.
CU of elective courses	**11**	**17.49**	There are 40 available credit unit which is distributed into 19 elective courses and students should take at least 11 course unit.
Total	**144**	**228.96**	

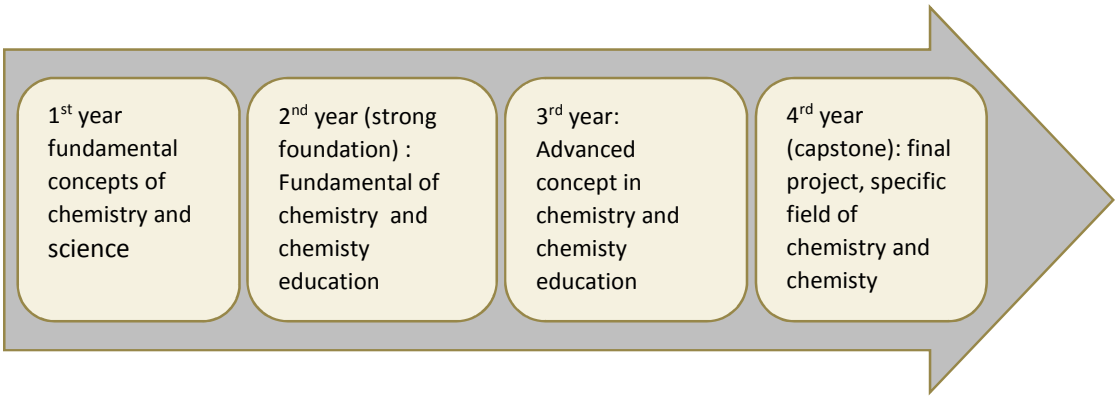

Figure 2. Model of curriculum structure of UPCE

2. Program Structure

The curriculum structure has been designed and harmonized with the vision and mission of the institution, input from stakeholders, KKNI, SSC ASIIN, PLO Competency Level, and Graduates Profile. Derived from the PEOs, the **Undergraduate Program of Education Chemistry (**UPCE) has the following Program Learning Outcomes (PLOs) for the graduates set as presented in Table 6.

Table 6. PLOs of UPCE

NO	ASPECTS	PLO	CODE
1	**KNOW LEDGE**	**PLO-01.** Capable to demonstrate knowledge related to theoretical concepts about structure, dynamics, and energy, as well as the basic principles of separation, analysis, synthesis and characterization of chemicals	**KNO-1**
		PLO-02. Capable to demonstrate the pedagogical knowledge of chemistry in designing, implementing, and evaluating chemistry learning	**KNO-2**
2	**SKILL**	**PLO-03.** Mastering the principles of ocupational health and safety, managing laboratories, using the equipment and operating chemical instruments	**SKI-1**

NO	ASPECTS	PLO		CODE
		PLO-04.	Capable to design, implement, evaluate, learn and develop chemistry learning media by utilizing Information and Communication Technology	**SKI-2**
3	**COMPETENCIES**	**PLO-05.**	Applying logical, critical, systematic and innovative thinking in the context of development or implementation of science, technology, and art that regards and applies humanities in accordance with chemistry education in solving problems	**COM-1**
		PLO-06.	Mastering the basics of the scientific method, designing and conducting research, writing scientific reports and communicating them both verbally and in writing by utilizing information and communication technology in the field of education	**COM-2**
4	**ATTITUDE AND SOCIAL**	**PLO-07.**	Capable to make decisions based on data/information in order to complete their responsibility assignment and evaluate the performance that has been done both individually and in groups, have an entrepreneurial spirit with environmental insight	**SOC-1**
		PLO-08.	Capable to adapt to various developments in chemistry, develop and learn continuously throughout life to continue education, both formal and informal	**SOC-2**

Based on the results of discussions from the ASIIN taskforce team, analysis of relevant curriculum documents and stakeholders, it is mapped as presented in Table 7. Table 7 presents the linkages between courses and PLO and the number of credits that must be taken by chemistry education students, namely 144 credits.

Table 7. Mapping MK vs PLO

No	Code	Course Title	CU	ECTS	PLO							
					1	2	3	4	5	6	7	8
1	8420402008	Digital Literacy	2	3.18					√			
2	1000002003	Indonesian	2	3.18						√		
3	8420403015	English	3	4.77						√		√
4	8420403039	General Biology	3	4.77						√		
5	8420403069	General Physics	3	4.77						√		
6	8420403123	Basic Chemistry 1	3	4.77	√		√					
7	8420403181	Basic Mathematics	3	4.77						√		
8	1000002018	Pancasila	2	3.18					√			
9	8420402018	English for Chemistry	2	3.18						√		
10	8420402094	Qualitative Analytical Chemistry	2	3.18	√		√					
11	8420403122	Basic Chemistry 2	3	4.77	√		√					
12	8420403141	Quantum Chemistry	3	4.77	√							√
13	8420402173	Conservation of Natural Resources and Environment	2	3.18						√		

No	Code	Course Title	CU	ECTS	PLO							
					1	2	3	4	5	6	7	8
14	8420403185	Mathematics for Chemistry	3	4.77	√							
15	1000002026	Religion	2	3.18					√			
16	1000002033	Citizenship Education	2	3.18					√			
17	8420402063	Philosophy of Science	2	3.18					√	√		√
18	1000002011	Cultural Social Science Association	2	3.18					√			
19	8420402090	Literature of Chemistry	2	3.18						√		
20	8420403098	Quantitative Analytical Chemistry	3	4.77	√		√		√			
21	8420403207	Laboratory Organization	3	4.77			√			√	√	
22	8420403164	Monofunction Organic Compound	3	4.77	√				√			
23	8420403119	Basic Theory of Inorganic Chemistry	3	4.77	√							
24	8420403140	Thermodynamics of Chemistry	3	4.77	√				√			√
25	8420403101	Basics of Chemical Separations	3	4.77	√				√			
26	8420402149	Nuclear Chemistry and Radiochemistry	2	3.18	√							
27	8420402116	Coordination Chemistry	2	3.18	√							
28	8420403135	Chemical Kinetics	3	4.77	√				√	√		√
29	8420403162	Polyfunction Organic Compound	3	4.77	√					√		
30	8420403261	Basic Statistics	3	4.77						√		√
31	8420402105	Electrochemistry Analysis	2	3.18	√				√			
32	8420402190	Spectroscopy and Chromatography Method	3	4.77	√					√		
33	8420402275	Entrepreneurship	2	3.18							√	√
33	8420403168	Surface Chemistry	3	4.77						√	√	√
34	8420402114	Main Elements of Inorganic Chemistry	2	3.18	√							
35	8420403192	Research Methodology	3	4.77					√	√		
36	8420402037	Structure and Function of Biomolecule	2	3.18	√				√		√	
37	8420402128	Pharmaceutical Chemistry	2	3.18	√							
38	8420402147	Industrial Chemistry	2	3.18						√	√	
39	8420403120	Transition Elements of Inorganic Chemistry	3	4.77	√							
40	8420403277	Community Service	3	4.77							√	√
41	8420403034	Metabolism and Pathways of Genetics Information	3	4.77	√				√		√	
42	8420402256	Seminar	2	3.18					√	√	√	
43	8420402167	Food Chemistry	2	3.18	√				√		√	
44	8420402221	Career Development	2	3.18						√		√
45	8420403154	Environmental Chemistry	3	4.77	√				√	√		
46	8420406259	Thesis	6	9.54	√		√			√		√

No	Code	Course Title	CU	ECTS	PLO							
					1	2	3	4	5	6	7	8
47	8420402001	Food Analysis	2	3.18	√				√	√		
48	8420402152	Cosmetics	2	3.18							√	
49	1000003006	Basic of Education	3	4.77		√						
50	1000002039	Educational Psychology	2	3.18		√						
51	8420403271	Learning Theories	3	4.77		√						
52	8420403012	Assessment	3	4.77		√						
53	8420403270	School Curriculum Analysis	3	4.77		√						
54	8420403187	Learning Media	3	4.77		√	√					
55	8420403211	Innovative Learning I	3	4.77		√	√	√				√
56	8420403212	Innovative Learning II	3	4.77		√	√	√			√	√
57	8420402188	Chemistry Game Media	2	3.18		√	√		√			
58	8420402224	Creative Learning Media Development	2	3.18		√		√	√			
59	8420402223	ICT Learning Media Development	2	3.18		√	√	√	√			
60	8420402171	School Chemistry	2	3.18		√		√				
61	8420403226	Microteaching	2	3.18		√		√				√
62	8420402180	School Management	2	3.18		√	√					
63	8420402215	ICT-based Learning Chemistry	2	3.18		√	√	√	√			
64	8420402216	Chemistry Learning for Vocational School	2	3.18		√	√					
65	8420403249	Teaching Internship	4	6.36		√	√	√				√
66	8420402011	Development of Assessment Instrument	2	3.18		√		√				
67	8420402282	Physical Education	2	3.18								√

The detailed courses structure of UPCE is shown in the Table 8.

Table 8. UPCE's Courses Structure for Each Semester

1st Semester					2nd Semester				
	Code	**Course Name**	**CU**	**ECTS**		**Code**	**Course Name**	**CU**	**ECTS**
1	1000002018	Pancasila	2	3.18	1	1000002033	Citizenship Education	2	3.18
2	1000002026	Religion Education	2	3.18	2	8420402008	Digital Literacy	2	3.18
3	1000003006	Basic of Education	3	4.77	3	1000002039	Educational Psychology	2	3.18
4	8420403015	English	3	4.77	4	8420402018	English for Chemistry	2	3.18
5	8420403039	General Biology*	3	4.77	5	8420402094	Qualitative Analytical Chemistry*	2	3.18
6	8420403069	General Physics*	3	4.77	6	8420402173	Conservation of Natural Resources and Environment	2	3.18
7	8420403123	Basic Chemistry 1*	3	4.77	7	8420403122	Basic Chemistry 2*	3	4.77
8	8420403181	Basic Mathematics	3	4.77	8	8420403185	Mathematics for Chemistry	3	4.77
					9	8420403271	Learning Theories	3	4.77
TOTAL			22	34.98	TOTAL			21	33.39

*) integrated with practicum

3rd Semester					4th Semester				
	Code	**Course Name**	**CU**	**ECTS**		**Code**	**Course Name**	**CU**	**ECTS**
1	1000002011	Basic Social and Cultural Sciences	2	3.18	1	8420403207	Laboratory Organization*	3	4.77
2	1000002003	Indonesian	2	3.18	2	8420403101	Basics of Chemical Separations*	3	4.77
3	8420403098	Quantitative Analytical Chemistry*	3	4.77	3	8420403119	Basic Theory of Inorganic Chemistry	3	4.77
4	8420403141	Quantum Chemistry	3	4.77	4	8420403140	Thermodynamics of Chemistry*	3	4.77
5	8420403164	Mono-function Organic Compound	3	4.77	5	8420403162	Poly-function Organic Compound*	3	4.77
6	8420402282	Physical Education	2	3.18	6	8420403187	Learning Media	3	4.77
7	8420403012	Assessment	3	4.77	7	8420403211	Innovative Learning I	3	4.77
8	8420403270	School Curriculum Analysis	3	4.77					
TOTAL			21	33.39		TOTAL		21	33.39

*) integrated with practicum

5th Semester					6th Semester				
	Code	Course Name	CU	ECTS		Code	Course Name	CU	ECTS
1	8420402037	Structure and Function of Biomolecule*	2	3.18	1	8420403034	Metabolism and Pathways of Genetics Information	3	4.77
2	8420402116	Coordination Chemistry	2	3.18	2	8420402114	Main Elements of Inorganic Chemistry*	2	3.18
3	8420402190	Spectroscopy and Chromatography Method*	3	4.77	3	8420402256	Seminar	2	3.18
4	8420402275	Entrepreneurship	2	3.18	4	8420402171	School Chemistry	2	3.18
5	8420403135	Chemical Kinetics*	3	4.77	5	8420403226	Microteaching	2	3.18
6	8420403192	Research Methodology	3	4.77	6	Elective Course		7	11.13
7	8420403212	Innovative Learning II	3	4.77					
8	8420403261	Basic Statistics	3	4.77					
TOTAL			21	33.39	TOTAL			18	28.62

*) integrated with practicum

7th Semester					8th Semester				
	Code	Course Name	CU	ECTS		Code	Course Name	CU	ECTS
1	8420403120	Transition Elements of Inorganic Chemistry*	3	4.77	1	8420406259	Thesis	6	9.54
2	8420403277	Community Service	3	4.77	2	Elective Course		2	3.18
3	8420403249	Teaching Internship	4	6.36					
4	Elective Course		2	3.18					
TOTAL			12	19.08	TOTAL			8	12.72

*) integrated with practicum

Table 9 UPCE's Elective Courses

Elective Course Odd Semester						Elective Course Even Semester					
No	Code	Course Name	CU	ECTS	Sem	No	Code	Course Name	CU	ECTS	Sem
1	8420402188	Chemistry Game Media	2	3.18	7	1	8420402090	Literature of Chemistry	2	3.18	6
2	8420402223	ICT Learning Media Development	2	3.18	7	2	8420402215	ICT-based Learning Chemistry	2	3.18	6
3	8420402224	Creative Learning Media Development	2	3.18	7	3	8420402216	Chemistry Learning for Vocational School	2	3.18	6

Elective Course Odd Semester						Elective Course Even Semester					
No	**Code**	**Course Name**	**CU**	**ECTS**	**Sem**	**No**	**Code**	**Course Name**	**CU**	**ECTS**	**Sem**
4	8420402063	Philosophy of Science	2	3.18	7	4	8420402180	School Management	2	3.18	6
5	8420402011	Development of Assessment Instrument	2	3.18	7	5	8420403168	Surface Chemistry	3	4.77	6
6	8420402167	Food Chemistry	2	3.18	7	6	8420403154	Environmental Chemistry	3	4.77	6
7	8420402152	Cosmetics	2	3.18	7	7	8420402221	Career Development	2	3.18	8
8	8420402001	Food Analysis	2	3.18	7	8	8420402128	Pharmaceutical Chemistry	2	3.18	8
						9	8420402147	Industrial Chemistry	2	3.18	8
						10	8420402149	Nuclear Chemistry and Radiochemistry	2	3.18	8
						11	8420402105	Electrochemistry Analysis	2	3.18	8

In the common first year, students are obliged to attend courses to provide a good foundation of natural science and basic education to acquire scientific thought towards the planning, development and evaluation of chemistry learning.

For UPCE students, four introductory courses are given, namely: (i) General Physics, (ii) General Biology, (iii) Basic Mathematics, and (iv) Learning Innovatives I and II. Meanwhile, with regards to the development of interpersonal capability, there are 7 supporting courses with a total of 14 credit units which are given to students, such as Religion, Bahasa Indonesia, Citizenship education, Cultural Social Science Association, Physical Education and Sports, Digital Literacy, and Psychology Education. Starting from the third semester, the students begin to learn about spatial and non-spatial basic elements and principles of learning chemistry. Afterwards, they learned about the substantive and procedural theories of chemistry education as well as methods and techniques in planning, teaching and evaluation.

Students are further encouraged to apply their knowledge in a series of student projects that are oriented towards teaching practice in the classroom and laboratory. Classes and laboratories are designed in problem-based learning settings and are student-centered in real conditions by taking classes or schools in the Indonesian region as case studies. Through this learning, students are trained to identify problems, formulate goals and objectives, carry out data collection and analysis, formulate alternative solutions, and evaluate the best

solutions to be recommended to relevant stakeholders, using rational, participatory, comprehensive, innovative and creative approaches. Further studies for more specific and/or supportive subjects can be fulfilled through elective courses provided internally at UPCE. This will give students the opportunity to sharpen their knowledge according to their specific interests. In addition, internships in schools as practice-based learning are also well integrated into the program structure. The study program concluded by taking a final project worth 6 CU.

The course roadmaps to achieving PLOs are shown in Figure 3-6. The roadmap also demonstrates that the curriculum structure consists of multi-discipline courses designed in 7 semesters in order to achieve the comprehensiveness in chemistry education. The roadmap also describes in different coloured boxes corresponding to the UPCE's PLO in Table 2. Figure 3 shows the roadmap for achieving PLO in knowledge aspect. Figure 4 shows the roadmap for achieving PLOs that are related to skills. Roadmap for achieving PLO in competencies aspect shown in Figure 5. Figure 6 illustrating roadmap for achieving PLO in attitude social aspect.

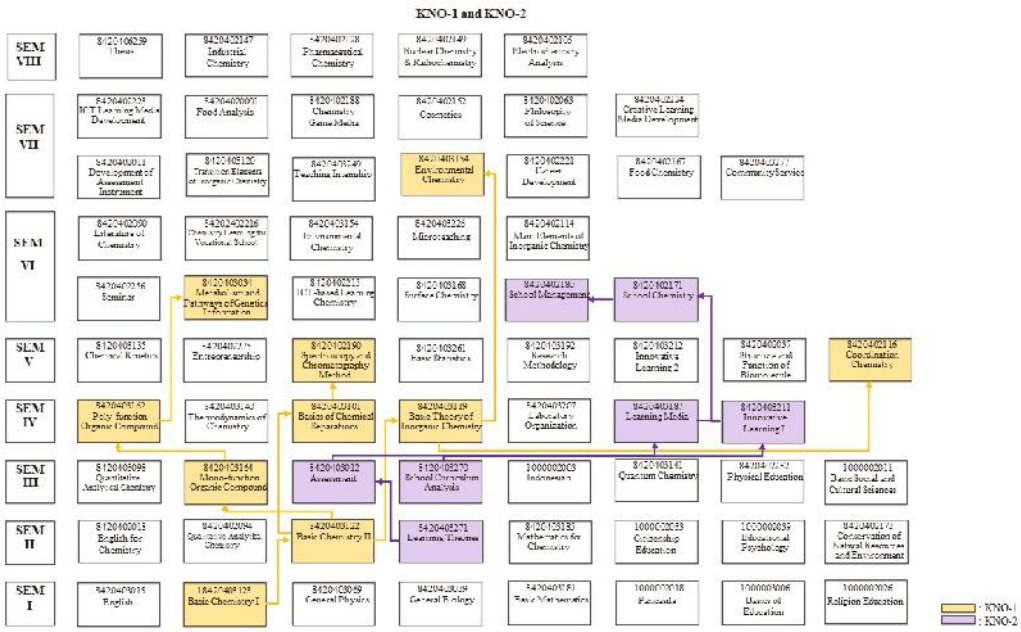

Figure 3 Roadmap for courses that support aspects of knowledge (PLO-1 and PLO-2)

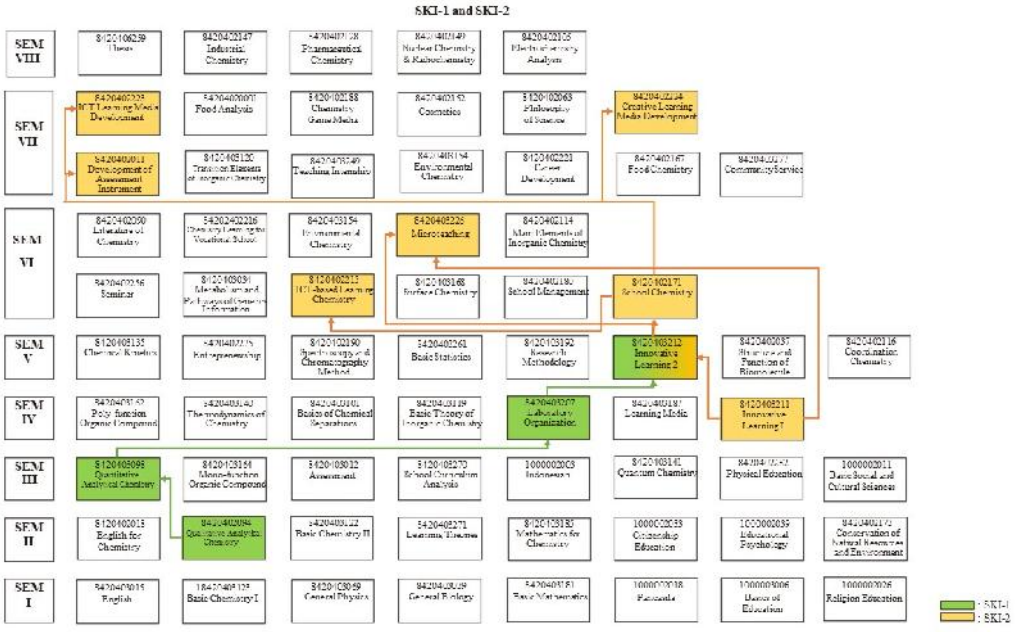

Figure 4 Roadmap for courses that support aspects of skills (PLO-3 and PLO-4)

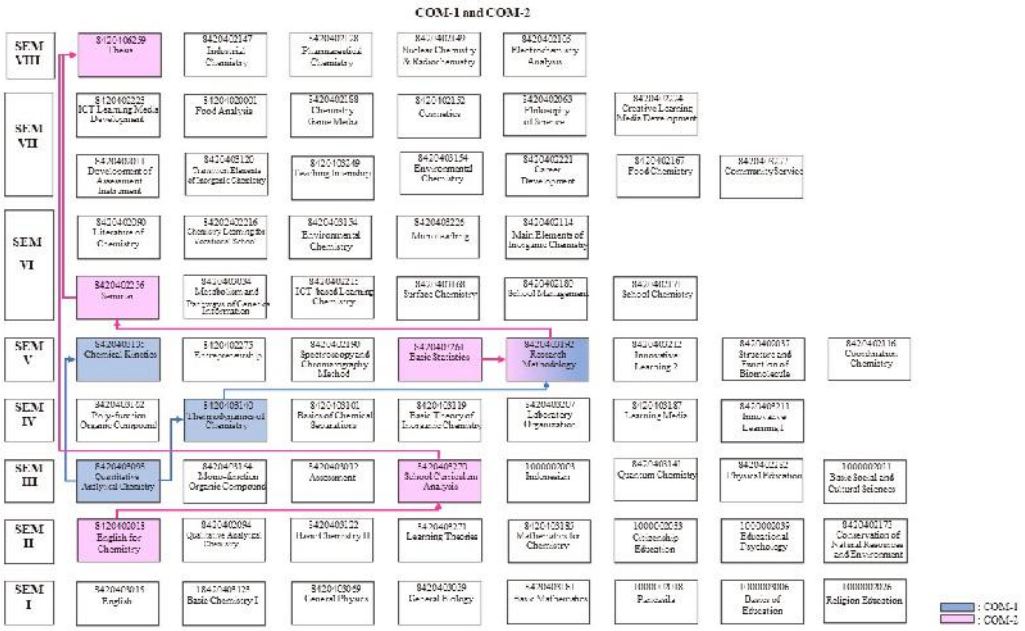

Figure 5 Roadmap for courses that support aspects of competencies (PLO-5 and PLO-6)

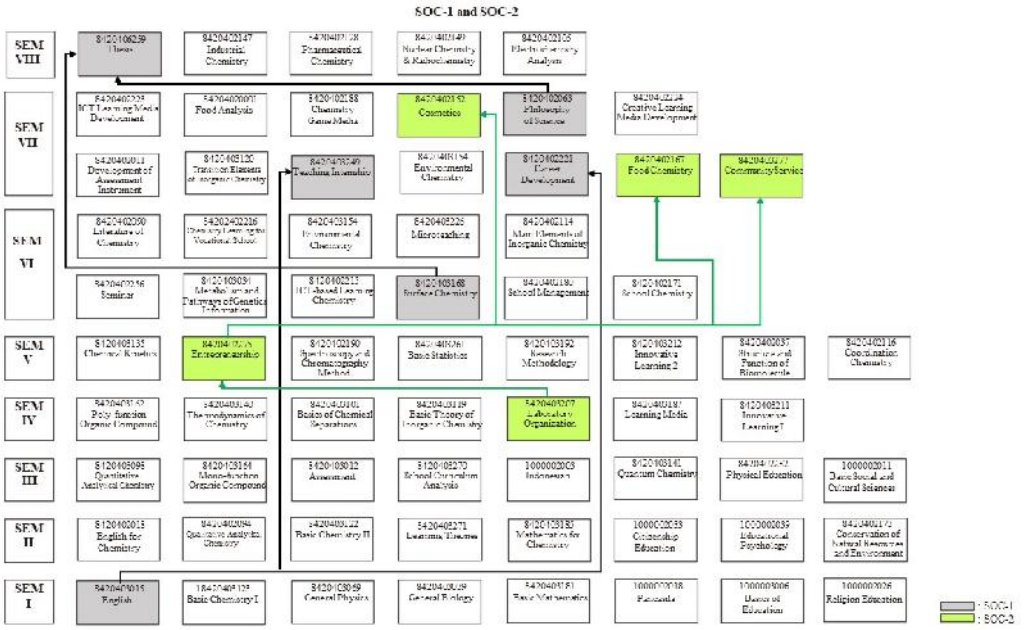

Figure 6 Roadmap for courses that support attitude aspects (PLO-7 and PLO-8)