SUMMARY OF CURRICULUM

UNDERGRADUATE PROGRAM OF CHEMISTRY EDUCATION
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS NEGERI SURABAYA
2025

A. OBJECTIVES OF THE DEGREE PROGRAM

Undergraduate Program of Chemistry Education (UPCE) belongs to Faculty of Mathematics and Natural Sciences (FMNS) at Universitas Negeri Surabaya (UNESA). This study program was established on 11 July 1996 based on the Decree of the Director General of Higher Education of the Department of Education and Culture of the Republic of Indonesia No. 247/DIKTI/Kep/1996. Objectives of this study program were derived from the visions and missions of institution and faculty as detailed in the following paragraphs.

1. The Vision and Mission of the Institution

In 2022, UNESA officially changed its institutional status from a Public Service Agency (BLU) to a State University with Legal Entity (PTNBH) status. Following this transition, UNESA established new institutional vision and missions as a State University with Legal Entity status.

Vision of Universitas Negeri Surabaya (Unesa):

"Becoming a strong, adaptive, and innovative educational university based on entrepreneurship"

Missions of Universitas Negeri Surabaya (Unesa):

a. To provide education in both educational and non-educational fields that is strong, adaptive, and innovative, based on entrepreneurship;
b. To conduct research and enhance the quality of innovation in educational and non-educational fields with an entrepreneurial foundation;
c. To carry out community service and disseminate innovations in educational and non-educational fields with an entrepreneurial basis for the welfare of society;
d. To implement the *Tridharma* of higher education through a multi-campus system in a synergistic, integrated, harmonious, and sustainable manner, while upholding Unesa's strengths;
e. To organize governance that is effective, efficient, transparent, and accountable, ensuring continuous quality improvement;
f. To establish productive national and international collaborations to create, develop, and disseminate innovations in educational and non-educational fields with an entrepreneurial foundation.

2. Vision and Mission of the Faculty

In alignment with UNESA's new vision, the Faculty of Mathematics and Natural Sciences has developed its own revised vision and missions to support the achievement of the university's goals.

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

"Becoming a resilient, adaptive, innovative, and collaborative Faculty of Mathematics and Natural Sciences based on edu-ecopreneurship and gaining international recognition"

The Faculty of Mathematics and Natural Sciences (FMIPA) uses the term edu-ecopreneurship to align the entrepreneurial points in UNESA's vision and mission with the faculty's vision and mission. Edu-ecopreneurship is a combination of edupreneurship (entrepreneurship in the educational process that encompasses both educational and non-educational fields) and ecopreneurship (entrepreneurship that prioritizes environmental sustainability), thereby interpreting edu-ecopreneurship as entrepreneurial behavior in the educational process that considers environmental sustainability. Eduecopreneurship involves creativity, innovation, and the courage to take risks in making educational changes. Edu-ecopreneurship includes eco-innovation (innovation in the educational process that contributes to reducing environmental burdens), eco-opportunities (the ability to utilize educational opportunities in the surrounding environment), and eco-commitment (the ability to work hard and be active in an environmentally friendly educational process).

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

a. To organize research-based education in the field of education and non-education of Mathematics and Natural Sciences that is adaptive, innovative, collaborative, and characterized by eduecopreneurship.
b. To conduct research and improve the quality of innovation in the field of MIPA education and non-education through global collaboration.
c. To organize community service and disseminate innovations in the field of MIPA education and non-education for community empowerment;
d. To organize effective, efficient, transparent, and accountable governance in FMIPA;
e. To establish productive national and international cooperation to create, develop, and disseminate innovations in the fields of MIPA education and non-education.

3. Vision of the Study Program

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

"Developing adaptive, innovative, and collaborative chemistry education and learning by utilizing Information and Communication Technology Media based on edu-ecopreneurship to produce graduates who have 21st-century skills and gain international recognition."

B. PROGRAM EDUCATIONAL OBJECTIVES (PEO)

To produce graduates with the expected qualifications, 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 of science and technology in the Industry 4.0 era. Each PEO is expected to be understood and implemented by every chemistry education graduate from the Chemistry education study program, 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, especially for 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 designed to prepare as teachers, managers of educational institutions, novice 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) 2023, 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, 2020. The development activities started with PLO Workshop based on the Indonesian Qualifications Framework (IQF) 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. 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 the university's visions, missions, and objectives.

Table 1 illustrates the linkage between the PEOs of UPCE and Level 6 of the IQF, the designated level for bachelor's education. Guided by these PEOs, UPCE graduates are expected to develop the competencies necessary to compete at both local and global levels.

Table 1. The Relationship between PEOs and the IQF

PEO vs IQF	Capable of apply science, technology, and art within his/her expertise 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
PEO-1	S	S	S	M
PEO-2	M	S	M	S
PEO-3	S	S	S	S
PEO-4	S	S	S	S
PEO-5	S	S	S	S

S-Strong, M-Moderate

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 staff/lecturers and students, while external stakeholders include 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 Qualification Framework (IQF), and Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers. Minister of Higher Education and Technology Regulation No. 53 of 2023 concerning National Standards for Higher Education (SNPT).

As part of its commitment to continuous improvement, UPCE has revitalized its curriculum and introduced the 2024–2028 transformative curriculum. The resulting Program Learning Outcomes (PLOs) are outlined in Table 2.

Table 2. PLOs of UPCE

Competency SSC-ASIIN	Aspect	PLO	DESCRIPTION
Social competences	**Attitudes 1 (AT-1)**	PLO 1	Demonstrates religious, national, and cultural values, as well as academic ethics, in carrying out their duties
	Attitudes 2 (AT-2)	PLO 2	Demonstrates a resilient, collaborative, adaptive, innovative, inclusive, lifelong learning, and entrepreneurial character
	General Skills 1 (GS-1)	PLO 3	Develops logical, critical, systematic, and creative thinking in carrying out specific work in the field of expertise and in accordance with the work competency standards in the relevant field.

Competency SSC-ASIIN	Aspect	PLO	DESCRIPTION
	General Skills 2 (GS-2)	PLO 4	Develops self-sustainably and collaborates.
	General Skills 3 (GS-3)	PLO 5	Makes decisions based on data/information to complete tasks that are their responsibility and evaluate the performance carried out both individually and in groups, and have an environmentally conscious edu-ecopreneurship spirit.
Specialist competences	**Knowledge 1 (KN-1)**	PLO 6	Demonstrates knowledge related to theoretical concepts of structure, dynamics, and energy, as well as the basic principles of separation, analysis, synthesis, and characterization of chemicals.
	Knowledge 2 (KN-2)	PLO 7	Demonstrates pedagogical knowledge of chemistry and applies it in designing, implementing, and evaluating learning.
	Knowledge 3 (KN-3)	PLO 8	Masters 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
	Knowledge 4 (KN-4)	PLO 9	Design, implement, evaluate learning, and develop chemistry learning media by utilizing Information and Communication Technology.
	Special Skills 1 (SS-1)	PLO 10	Develops or implements science, technology, and art that pay attention to and apply humanities values that are appropriate to the field of chemistry education in solving problems.
	Special Skills 2 (SS-2)	PLO 11	Masters the basics of scientific methods, designing and implementing research, compiling scientific reports, and communicating them both orally and in writing by utilizing information and communication technology in the field of education

Correlation between the PEOs and the PLOs is shown in Table 3

Table 3. Correlation between the PEOs and the PLOs of UPCE

Competency SSC-ASIIN	Aspect	PLO	PEO 01	PEO 02	PEO 03	PEO 04	PEO 05
Social competences	**Attitudes (AT)**	PLO-1		√	√		
		PLO-2		√	√		
	General Skills (GS)	PLO-3		√	√	√	
		PLO -4		√	√	√	
		PLO -5		√	√		√
Specialist competences	**Knowledge (KN)**	PLO -6	√				√
		PLO -7	√				√
		PLO -8	√				√
		PLO -9	√	√			√
	Special Skills	PLO -10	√				√
		PLO -11	√	√		√	

Note: √ support

he correlation matrix in Table 3 demonstrates a comprehensive and intentional alignment between the Programme Learning Outcomes (PLOs) and the Programme Educational Objectives (PEOs) of UPCE. Each PLO is mapped to all five PEOs, reflecting a holistic curriculum design that integrates cognitive, affective, and psychomotor domains across the graduate profile.

Table 4. Program Learning Outcome (PLO) vs Subject Specific Criteria (SSC) ASIIN

Subject Specific Criteria (SSC)	PLO										
	Social competences					Specialist competences					
	1	2	3	4	5	6	7	8	9	10	11
	AT-1	AT-2	GS-1	GS-2	GS-3	KN-1	KN-2	KN-3	KN-4	SS-1	SS-2
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 contexts, 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 content 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, mixed-gender **groups**,				√	√						
14. are familiar with the basic principles for conduction of **projects** and are 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 2021-2024. 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 the roof that includes all knowledge in the field of chemical education.

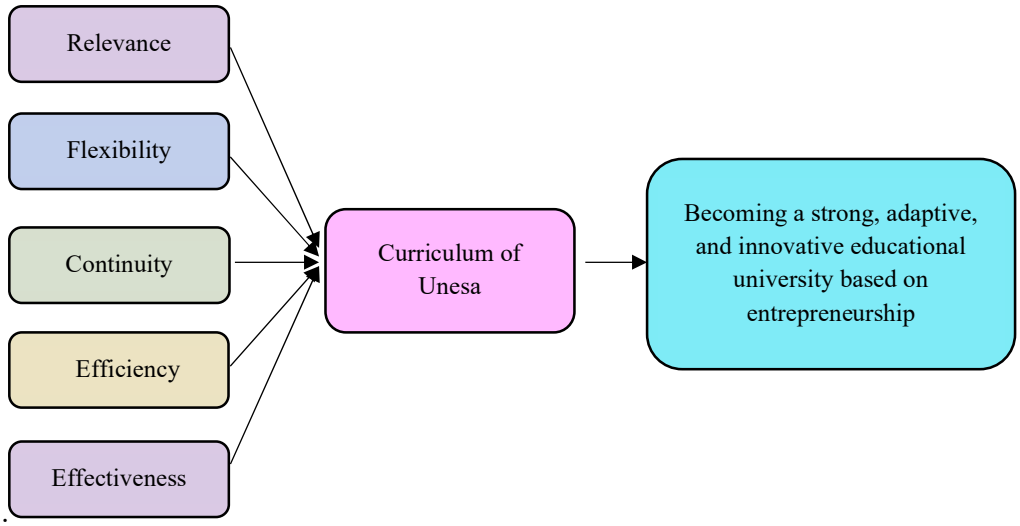

Figure 1. Principles of curriculum development

The minimum workload of Undergraduate Program at Unesa is 144 credit units (CU), which corresponds to 6,523.2 hours[1] or 229 ECTS[2], and is generally distributed in 8 regular semesters. On average, the total hours per semester are 815.4 hours. The normal workload for each regular semester is limited to 1,035 hours, which corresponds to 20 CU (31.80 ECTS).

Note:

*[1] Referring to **The Decree of Rector Unesa No. 736/HK/KM/2023**, 1 CU for bachelor's degree equals to 170 minutes per week (50' face-to-face learning, 60' structured learning, and 60' independent learning). For one semester, each course is conducted in 16 weeks (excluding midterm and final exams). Thus, 1 CU equals to 16 weeks × 170 minutes = 2,720 minutes or 45.3 hours.*
[2] 1 CU equals to 1.59 ECTS, assuming that 1 ECTS equals to 28.48 work hours per semester..

Table 5. Compulsory and elective courses in UPCE

CU Compulsory courses	CU	ECTS	Note
CU of compulsory courses	**120**	**190.80**	The CU courses are distributed into 49 compulsory courses.
CU of elective courses	**24**	**38.16**	There are 84 available credit units, which are distributed into 36 elective courses, and students should take at least 24 course units.
Total	**144**	**228.96**	

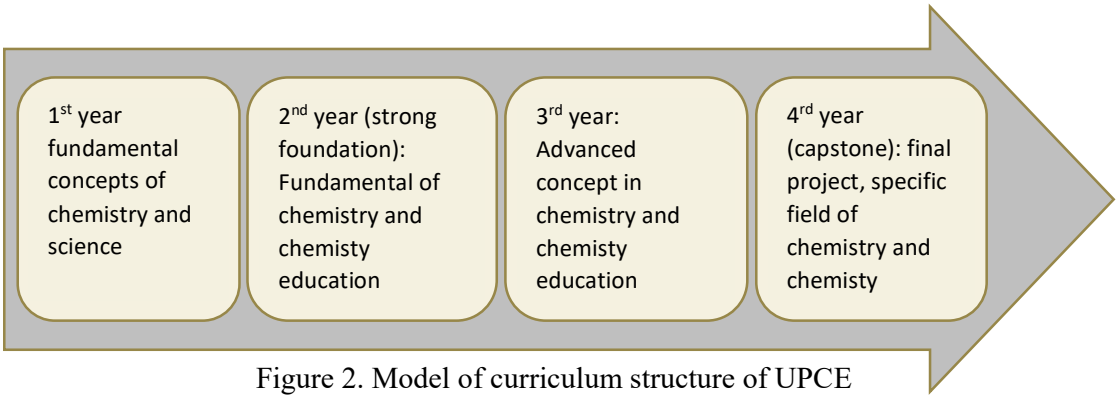

Figure 2. Model of curriculum structure of UPCE

2. Program Structure

The curriculum structure has been designed and harmonized with the vision and mission of the institution, input from stakeholders, IQF, SSC ASIIN, PLO Competency Level, and the Graduates Profile. 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 6. Table 6 presents the linkages between courses and PLO and the number of credits that must be taken by chemistry education students, namely 144 credits.

Table 6. Mapping Course Title vs PLO

No	Code	Course Title	CU	ECTS	PLO										
					Social competences					Specialist competences					
					1	2	3	4	5	6	7	8	9	10	11
					AT-1	AT-2	GS-1	GS-2	GS-3	KN-1	KN-2	KN-3	KN-4	SS-1	SS-2
1	8420403039	General Biology	3	4.77											√

No	Code	Course Title	CU	ECTS	PLO										
					Social competences					Specialist competences					
					1	2	3	4	5	6	7	8	9	10	11
					AT-1	AT-2	GS-1	GS-2	GS-3	KN-1	KN-2	KN-3	KN-4	SS-1	SS-2
2	8420403287	Basic of Analytical Chemistry	3	4.77						√					√
3	8420402319	Basic of Education	2	3.18							√				
4	8420403069	General Physics	3	4.77											√
5	8420403121	Basic Chemistry	3	4.77						√		√			√
6	8420402323	Basic Mathematics	2	3.18											√
7	1000002018	Pancasila	2	3.18	√										
8	8420402297	Learning Theories	2	3.18				√			√			√	
9	100000202x	Religion Education	2	3.18	√										
10	8420403331	Basics of Chemical Separations	3	4.77						√					√
11	8420402293	Evaluation of Learning and Teaching	2	3.18							√		√		
12	1000002033	Citizenship	2	3.18	√										
13	8420403303	Quantum Chemistry	3	4.77				√		√					√
14	8420402173	Conservation of Natural Resources and Environment	2	3.18			√		√					√	√
15	8420402328	School Curriculum	2	3.18							√		√	√	
16	8420402291	Development of Teaching Materials	2	3.18					√		√		√		
17	8420402292	Learning Planning	2	3.18			√				√		√		
18	1000002003	Indonesian	2	3.18	√		√								
19	1000002046	Digital Literacy	2	3.18			√	√							
20	8420402190	Spectroscopy and Chromatography Method	3	4.77						√					√
21	8420403294	Innovative Learning	3	4.77							√		√		
22	8420402215	ICT-based Learning Chemistry	2	3.18							√		√		
23	8420403318	Mono-function Organic Compound	3	4.77			√		√	√				√	
24	8420402329	Statistics	2	3.18										√	√
25	8420403315	Basic Theory of Inorganic Chemistry	3	4.77			√			√				√	
26	8420403316	Thermodynamics of Chemistry	3	4.77					√	√					√
27	1000002177	English	2	3.18		√	√								
28	8420404332	Biochemistry	3	4.77			√			√		√			
29	8420402295	Teaching Skills and Microteaching	2	3.18						√	√		√		
30	8420402151	Coordination Chemistry	2	3.18			√			√				√	
31	8420402171	School Chemistry	2	3.18						√	√				
32	8420403306	Chemical Kinetics	3	4.77			√	√		√					
33	8420403192	Research Methodology	3	4.77										√	√

No	Code	Course Title	CU	ECTS	PLO										
					Social competences					Specialist competences					
					1	2	3	4	5	6	7	8	9	10	11
					AT-1	AT-2	GS-1	GS-2	GS-3	KN-1	KN-2	KN-3	KN-4	SS-1	SS-2
34	8420402208	Laboratory Organization	2	3.18			√		√			√			
35	1000002047	Physical Education and Fitness	2	3.18		√									
36	8420403317	Poly-function Organic Compound	3	4.77			√		√	√					√
37	8420402063	Philosophy of Science	2	3.18	√		√							√	√
38	1000002176	Entrepreneurship	2	3.18		√		√							
39	MBKM00xx	Community Service Program - evaluation program	2	3.18	√		√	√							
40	MBKM00yy	Community Service Program - program planning	2	3.18	√	√	√	√							
41	1000020158	Critical and Creative Thinking	2	3.18			√	√							
42	1000020161	Communication and Teamwork	2	3.18		√		√							
43	1000020160	Empathy and Emotional Intelligence	2	3.18		√		√							
44	1000020162	Soft Skills	2	3.18		√			√						
45	1000020163	Communication skills	2	3.18			√								
46	8420404339	Public communication	4	6.36			√						√		√
47	8420404341	Data literacy	4	6,36			√		√				√		√
48	8420404338	Management and leadership	4	6.36		√	√		√						√
49	8420404340	Innovative Thinking	4	6.36			√		√				√		√
50	MBKM0032	Teaching Internship: Program Design	2	3.18	√	√	√	√							
51	MBKM0031	Teaching Internship: Program Evaluation	2	3.18	√		√	√							
52	8420402342	School Curriculum Analysis	2	3.18							√			√	
53	8420403345	Learning Plan Development	3	4.77			√				√		√		
54	8420402343	Learning Assessment Development	2	3.18							√		√		
55	8420403344	Analysis Of Teaching Materials	3	4.77					√		√		√		
56	8420402222	Learning Media Development	2	3.18							√		√	√	
57	8420404346	Teaching Practice	4	6.36						√	√		√		
58	8420403325	Elemental Chemistry	3	4.77			√			√		√			√
59	8420402001	Food Analysis	2	3.18						√					√
60	8420402153	Environmental Chemistry	2	3.18						√					√
61	8420402167	Food Chemistry	2	3.18		√			√	√				√	

No	Code	Course Title	CU	ECTS	PLO										
					Social competences					Specialist competences					
					1	2	3	4	5	6	7	8	9	10	11
					AT-1	AT-2	GS-1	GS-2	GS-3	KN-1	KN-2	KN-3	KN-4	SS-1	SS-2
62	8420402302	Natural Product Chemistry	2	3.18			√			√		√			
63	8420402128	Pharmaceutical Chemistry	2	3.18			√	√	√			√			
64	8420402147	Industrial Chemistry	2	3.18					√	√					√
65	8420402152	Cosmetics	2	3.18		√			√	√					
66	8420402322	Surface Chemistry	2	3.18			√							√	√
67	8420402333	Green Chemistry	2	3.18			√		√			√			√
68	8420402180	School Management	2	3.18									√	√	
69	8420402309	Chemistry Game Media	2	3.18							√		√	√	
70	8420402334	Multirepresentation of Chemistry	2	3.18			√						√	√	
71	8420402216	Chemistry Learning for Vocational School	2	3.18				√			√				
72	8420402011	Development of Assessment Instrument	2	3.18						√	√		√		
73	8420402221	Career Development	2	3.18			√				√	√		√	
74	8420402223	ICT Learning Media Development	2	3.18							√		√	√	
75	8420402224	Creative Learning Media Development	2	3.18					√		√			√	
76	8420402347	AI for Chemistry Learning	2	3.18							√		√		
77	8420402336	Chemistry Education for Students with Special Needs	2	3.18							√			√	√
78	1000002104	Final Project Proposal	2	3.18						√				√	√
79	1000004105	Final Project	4	6.36				√		√		√			√

The detailed course structure of UPCE is shown in Table 7.

Table 7. UPCE's Course 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	100000202x	Religion Education	2	3.18
2	8420403039	General Biology#	3	4.77	2	8420403331	Basics of Chemical Separations#	3	4.77
3	8420403287	Basic of Analytical Chemistry#	3	4.77	3	8420402293	Evaluation of Learning and Teaching	2	3.18
4	8420402319	Basic of Education	2	3.18	4	1000002033	Citizenship	2	3.18
5	8420403069	General Physics#	3	4.77	5	8420403303	Quantum Chemistry	3	4.77
6	8420403123	Basic Chemistry#	3	4.77	6	8420402173	Conservation of Natural Resources and Environment	2	3.18

1st Semester					2nd Semester				
	Code	Course Name	CU	ECTS		Code	Course Name	CU	ECTS
7	8420402323	Basic Mathematics	2	3.18	7	8420402328	School Curriculum	2	3.18
8	8420403181	Learning Theories	2	3.18	8	8420402291	Development of Teaching Materials	2	3.18
					9	8420402292	Learning Planning	2	3.18
TOTAL			20	31.80	TOTAL			20	31.80

#) integrated with practicum

3rd Semester					4th Semester				
	Code	Course Name	CU	ECTS		Code	Course Name	CU	ECTS
1	1000002003	Indonesian	2	3.18	1	1000002177	English	2	3.18
2	1000002046	Digital Literacy	2	3.18	2	8420404332	Biochemistry#	3	4.77
3	8420402190	Spectroscopy and Chromatography Method#	3	4.77	3	8420402295	Teaching Skills and Microteaching	2	3.18
4	8420403294	Innovative Learning	3	4.77	4	8420402151	Coordination Chemistry	2	3.18
5	8420402215	ICT-based Learning Chemistry	2	3.18	5	8420403317	Poly-function Organic Compound#	3	4.77
6	8420403318	Mono-function Organic Compound	3	4.77	6	8420403306	Chemical Kinetics#	3	4.77
7	8420402329	Statistics	2	3.18	7	8420403192	Research Methodology	3	4.77
8	8420403315	Basic Theory of Inorganic Chemistry	3	4.77	8	8420402208	Laboratory Organization	2	3.18
9	8420403316	Thermodynamics of Chemistry#	3	4.77	9	1000002047	Physical Education and Fitness	2	3.18
					10	8420402171	School Chemistry	2	3.18
TOTAL			23	36.57		TOTAL		24	38.16

#) integrated with practicum

5th Semester					6th Semester				
	Code	Course Name	CU	ECTS		Code	Course Name	CU	ECTS
1	8420402063	Philosophy of Science	2	3.18	1	MBKM0032	Teaching Internship: Program Design	2	3.18
2	1000002176	Entrepreneurship	2	3.18	2	MBKM0031	Teaching Internship: Program Evaluation	2	3.18
3	Elective Course		20	31.8	3	Elective Course		16	25.45
TOTAL			24	38.16	TOTAL			20	31.8

7th Semester					8th Semester				
	Code	Course Name	CU	ECTS		Code	Course Name	CU	ECTS
1	8420403325	Elemental Chemistry#	3	4.77	1	1000004105	Final Project	4	6.36
2	1000002104	Final Project Proposal	2	3.18	2	Elective Course		2	3.18
3	Elective Course		2	3.18					
TOTAL			12	19.08	TOTAL			6	9.54

#) integrated with practicum

Table 8. 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	MBKM00xx	Community Service Program - evaluation program***	2	3.18	5	1	8420402342	School Curriculum Analysis**	2	3.18	6
2	MBKM00yy	Community Service Program - program planning ***	2	3.18	5	2	8420403345	Learning Plan Development**	3	4.77	6
3	1000020158	Critical and Creative Thinking***	2	3.18	5	3	8420402343	Learning Assessment Development**	2	3.18	6
4	1000020163	Communication skills***	2	3.18	5	4	8420403344	Analysis Of Teaching Materials**	3	4.77	6
5	1000020160	Empathy and Emotional Intelligence***	2	3.18	5	5	8420402222	Learning Media Development**	2	3.18	6
6	1000020161	Communication and Teamwork***	2	3.18	5	6	8420404346	Teaching Practice**	4	6.36	6
7	1000020162	Soft Skills***	2	3.18	5	7	8420402001	Food Analysis*	2	3.18	8
8	8420404339	Public communication ***	4	6.36	5	8	8420402128	Pharmaceutical Chemistry*	2	3.18	8
9	8420404341	Data literacy***	4	6.36	5	9	8420402147	Industrial Chemistry*	2	3.18	8
10	8420404338	Management and leadership ***	4	6.36	5	10	8420402152	Cosmetics*	2	3.18	8
11	8420404340	Innovative Thinking***	4	6.36	5	11	8420402322	Surface Chemistry*	2	3.18	8
12	8420402302	Natural Product Chemistry*	2	3.18	7	12	8420402333	Green Chemistry*	2	3.18	8
13	8420402153	Environmental Chemistry*	2	3.18	7	13	8420402216	Chemistry Learning for Vocational School*	2	3.18	8
14	8420402167	Food Chemistry*	2	3.18	7	14	8420402221	Career Development*	2	3.18	8
15	8420402180	School Management*	2	3.18	7	15	8420402347	AI for Chemistry Learning*	2	3.18	8
16	8420402309	Chemistry Game Media*	2	3.18	7						
17	8420402334	Multirepresentation of Chemistry *	2	3.18	7						
18	8420402011	Development of Assessment Instrument*	2	3.18	7						

Elective Course Odd Semester						Elective Course Even Semester					
No	**Code**	**Course Name**	**CU**	**ECTS**	**Sem**	**No**	**Code**	**Course Name**	**CU**	**ECTS**	**Sem**
19	8420402223	ICT Learning Media Development*	2	3.18	7						
20	8420402224	Creative Learning Media Development*	2	3.18	7						
21	8420402336	Chemistry Education for Students with Special Needs *	2	3.18	7						

Note: *UPCE Elective Courses;
**Courses of Teaching Internship
*** Elective Courses of Academic Mobility Program (AMP).

- [1] *Referring to **The Decree of Rector Unesa No. 736/HK/KM/2023**, 1 CU for bachelor's degree equals to 170 minutes per week (50' face-to-face learning, 60' structured learning, and 60' independent learning). For one semester, each course is conducted in 16 weeks (excluding midterm and final exams). Thus, 1 CU equals to 16 weeks × 170 minutes = 2,720 minutes or 45.3 hours.*
- [2] *1 CU equals to 1.59 ECTS, assuming that 1 ECTS equals to 28.48 work hours per semester..*

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. Meanwhile, with regard to the development of interpersonal capability, there are 8 supporting courses with a total of 16 credit units which are given to students, such as Pancasila, Religion, Citizenship, Indonesian, Physical Education and Sports, Digital Literacy, English, and Entrepreneurship. 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 proposal (2 CU) and final project worth 4 CU.

The course roadmaps to achieving PLOs are shown in Figure 3-7. The roadmap also demonstrates that the curriculum structure consists of multi-disciplinary courses designed in 7 semesters in order to achieve comprehensiveness in chemistry education. The roadmap also describes in different coloured boxes corresponding to the UPCE's PLO in Table 6. Figure 3 shows the roadmap for achieving PLO in the attitude aspect. Figure 4 shows the roadmap for achieving PLOs that are related to general skills. Roadmap for achieving PLO in the knowledge aspect is shown in Figures 5 and 6. Figure 7 illustrates a roadmap for achieving PLO in the special skill aspect.

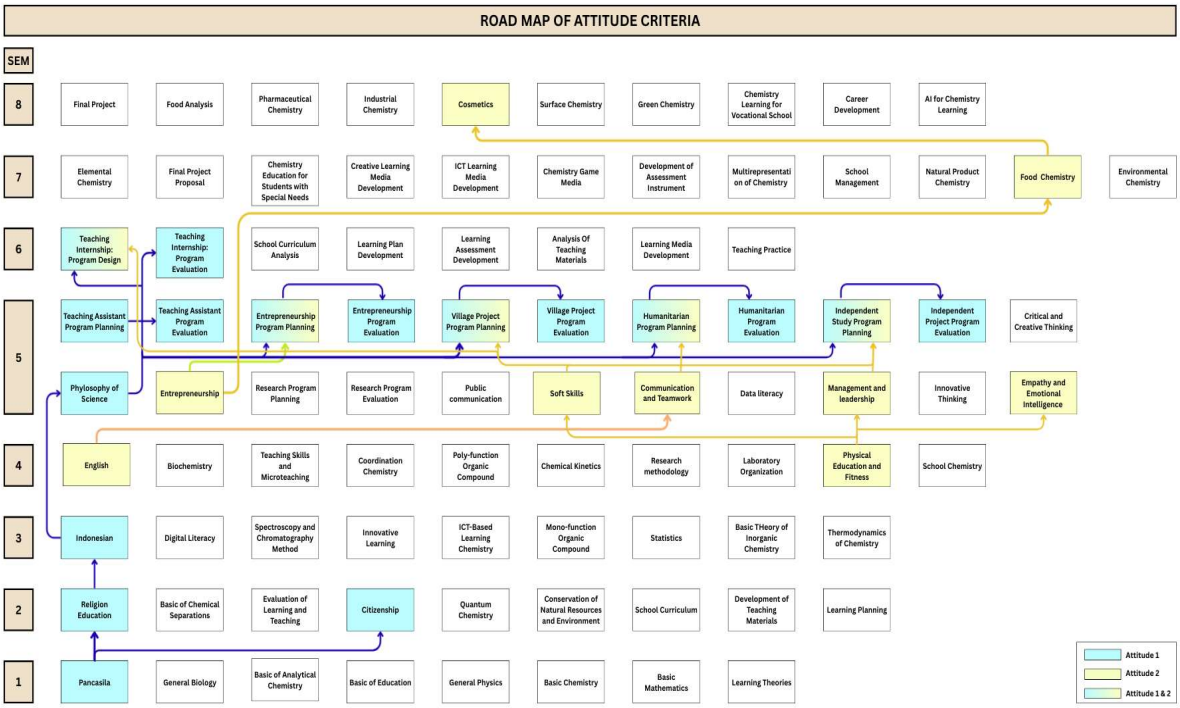

Figure 3. Roadmap for courses that support aspects of attitude (PLO-1/AT-1 & PLO-2/AT-2)

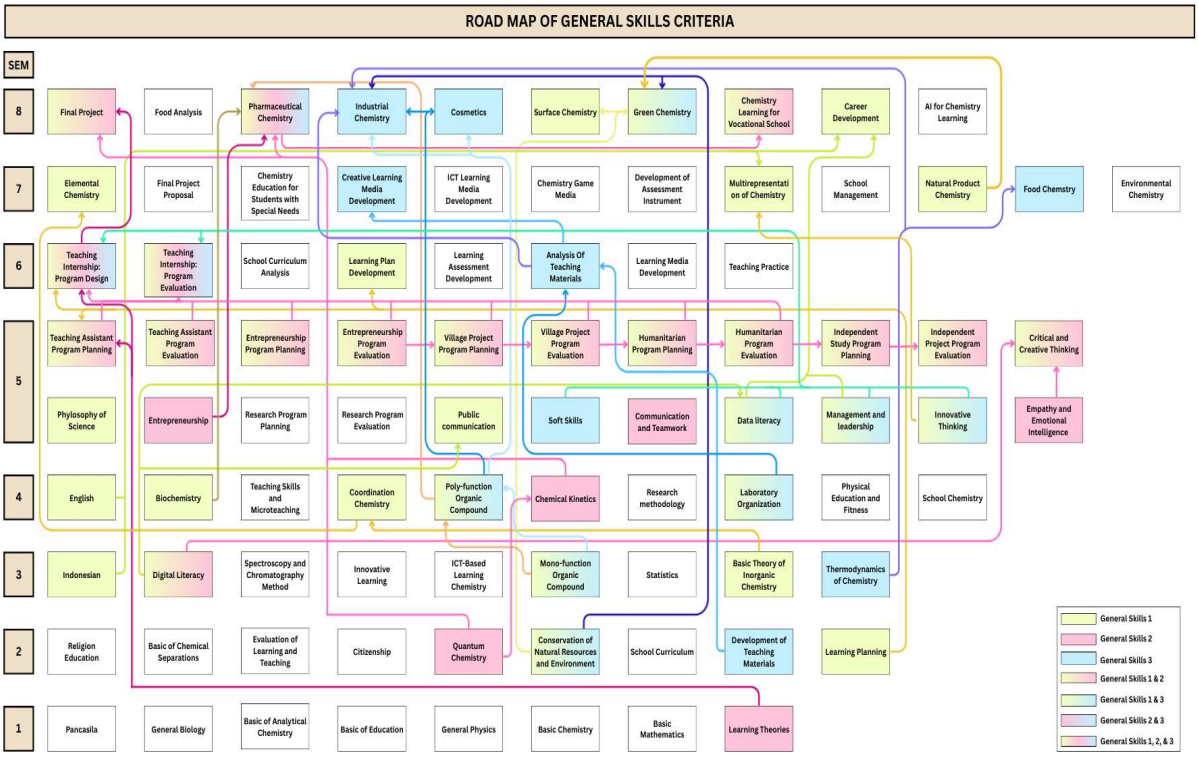

Figure 4. Roadmap for courses that support aspects of general skills (PLO-3/GS-1, PLO-4/GS-2, & PLO-5/GS-3)

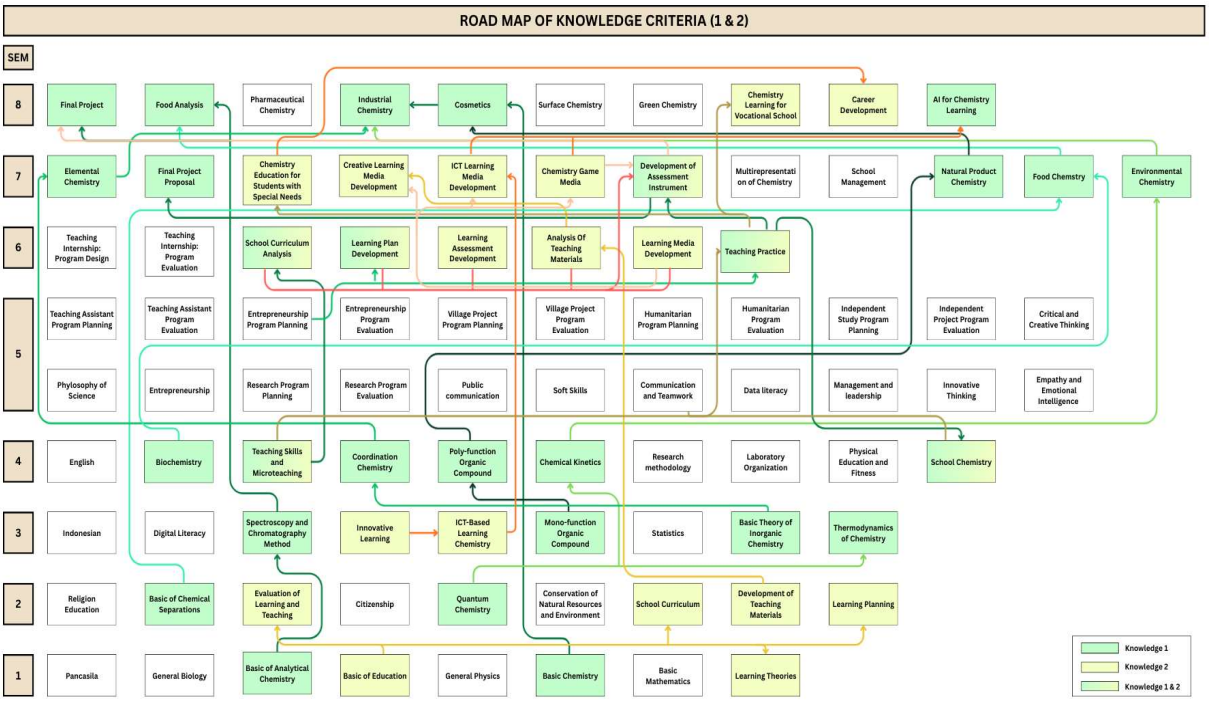

Figure 5. Roadmap for courses that support knowledge (PLO-6/KN-1 & PLO-7/KN-2)

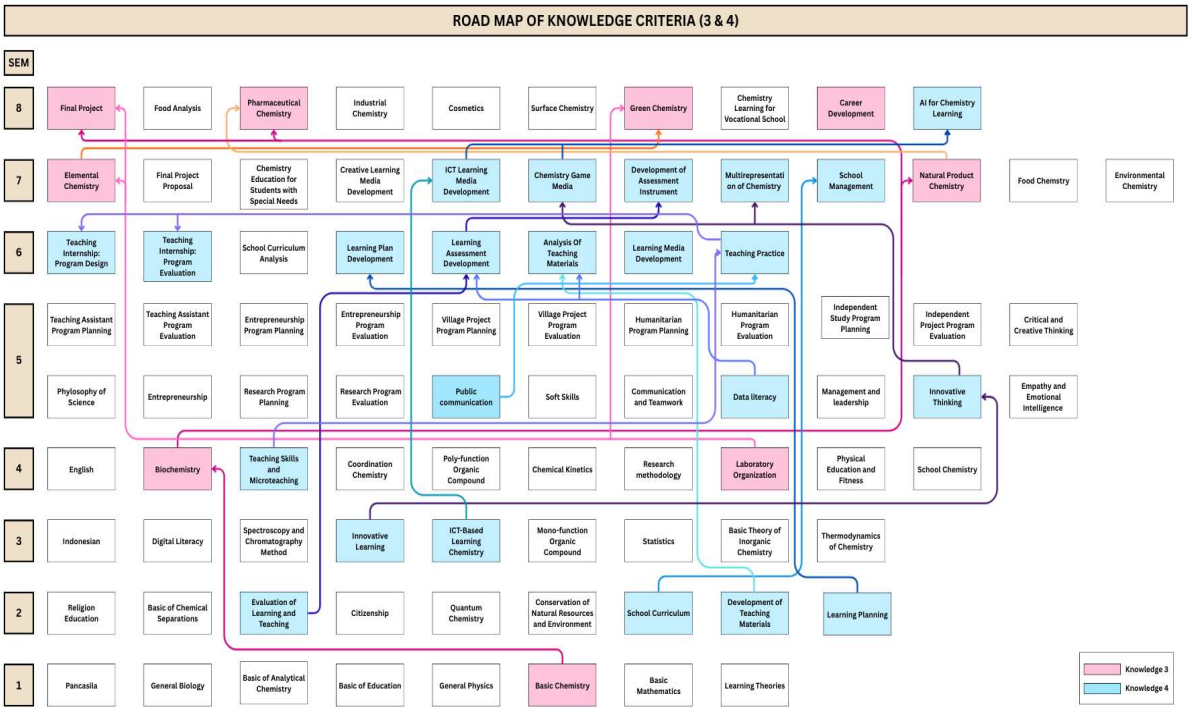

Figure 6. Roadmap for courses that support knowledge (PLO-8/KN-3 & PLO-9/KN-4)

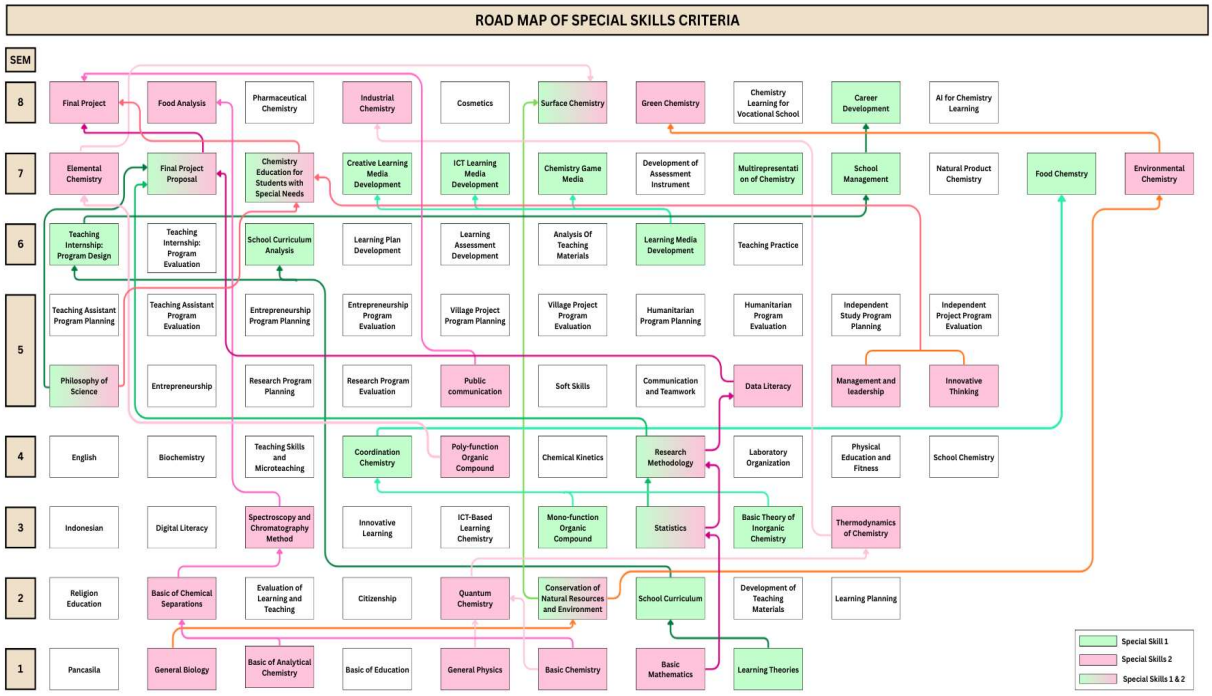

Figure 7. Roadmap for courses that support special skills (PLO-10/SS-1 and PLO-11/SS-2)