SUMMARY OF CURRICULUM



UNDERGRADUATE PROGRAMME IN SCIENCE EDUCATION
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS NEGERI SURABABAYA
2021

OBJECTIVE OF THE DEGREE PROGRAM

The Undergraduate Program of Science Education (UPSE) belongs to Department of Natural Science at Faculty of Mathematics and Natural Sciences (FMNS) in Universitas Negeri Surabaya (UNESA). This study program was established on 21 December 2006 based on the Decree of General Director of Higher Education of the National Education Department of Indonesia No. 4905/D/T/2006. 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 Institution**

Vision of Universitas Negeri Surabaya:

Excellent in Education, Strong in Science

Mission of Universitas Negeri Surabaya:

(1) To organize education and learning centered on students by using effective learning approaches and technology

(2) To conduct research in education, natural sciences, social and cultural sciences, arts, and/or sports, and technological development whose findings are beneficial for the development of science and public welfare

(3) To disseminate science, technology, arts, culture and sports, and research results through community service oriented towards empowering and accustoming society

(4) To embody Universitas Negeri Surabaya as a center of education not only for primary and secondary education but also for scientific centers based on the noble values of national culture

(5) To organize autonomous, accountable, and transparent governance for quality assurance and quality improvement.

2. **The Vision and Mission of Faculty**

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

Excellent in Educational Mathematics and Natural Science, Strong in Mathematics and Natural Science Studies

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

(1) Excellence in mathematics and natural science education innovation.

(2) Strength not only in mathematics and natural sciences studies and its application but also be able to reinforce mathematics and natural science education (wider mandate).

(3) Excellence in global competition.

(4) Excellence graduates who are environmentally minded and have an entrepreneurial spirit.

The term "excellent" referred to the FMNS Vision means to be innovative, competitive, and always trying to improve quality. The term "strong" means to work systematically, methodically, and objectively, in order to support the excellence of the studies in mathematics and natural sciences.

Mission of FMNS

(1) To organize innovative and research-based mathematics and natural sciences education in order to produce graduates who have environmental insight, an entrepreneurial spirit and global competitiveness.

(2) To conduct mathematics and natural sciences research in strengthening science that is recognized nationally and internationally as well as strengthening mathematics and natural science education.
(3) To organize research-based community service for supporting the community welfare.
(4) To build a strong network with stakeholders for improving the quality and image of FMNS.
(5) To organize autonomous, credible, fair, accountable, and transparent governance for quality assurance and quality improvement in FMNS.

Objectives of FMNS

a) To produce graduates of MNS and MNS education who have environmental insight, entrepreneurial spirit, and global competitiveness.
b) To produce MNS research and MNS education products to strengthen MNS and MNS education.
c) To implement the result of the research for community service in order to support community welfare.
d) To build strong collaboration with stakeholders for improving the quality and image of FMNS.
e) To build a system in FMNS that is autonomous, credible, fair, accountable, and transparent for quality assurance and quality improvement.

3. Program Educational Objectives (PEO)

As a consequence of the vision and mission of UNESA and FMNS in accordance to a Rector Decree no. 466/UN38/HK/DT/2016 about Curriculum development based on the Indonesian National Qualification Framework (KKNI) for study program, the Program Educational Objectives (PEOs) of UPSE focus on producing graduates who are capable of becoming science educators particularly at middle school level, researchers of science education, and entrepreneurs in the fields of applied science or science education. In detail, the PEOs of UPSE are as follows:

1. Mastering knowledge / skills in the field of pedagogical integrated science (physics, chemistry, and biology) to carry out their professional or entrepreneurial tasks (PEO 1);
2. Having responsibility in carrying out his professional duties based on professional ethics (PEO 2);
3. Having a strong and tough personality and be able to compete globally in carrying out the tasks of his profession or entrepreneurship (PEO 3);
4. Having capability to communicate and work together in carrying out professional tasks (PEO 4);
5. Having capability to do self-development and innovations sustainably based on the situation and challenges in their professional duties (PEO 5).

The PEOs were formulated by considering the input from alumni and science education experts, curriculum for middle school students, evaluation results of tracer studies, and National Science Education Standards (NSES) 1996. These PEOs also have significant relevancies with the Indonesian National Qualification Framework (KKNI). Table 1 indicates the relationship between PEO(s) of UPSE and the 6th level (the level for bachelor education) of the National

Qualification Framework. Through these PEOs, the graduates of UPSE are expected to have capability to compete locally and globally.

Table 1. The Relationship between PEOs of UPSE and the Indonesian National Qualification Framework

	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	S	S	S	S
PEO 3	S	S	S	S
PEO 4	M	S	M	S
PEO 5	S	S	S	S

S-Strong, M-Moderate

4. Program Learning Outcomes (PLO)

Derived from the PEOs, the UPSE proposed Program Learning Outcomes (PLOs) as shown in Table 2.

Table 2. PLO of UPSE

Competency SSC-ASIIN	Aspect	PLO	DESCRIPTION
Specialist competences	**Knowledge**	PLO 1	Demonstrate basic knowledge of physics, chemistry, and biology.
		PLO 2	Demonstrate knowledge of integrated science (physics, chemistry, and biology).
		PLO 3	Demonstrate pedagogical knowledge of designing, implementing, and evaluating integrated science learning.
		PLO 4	Demonstrate knowledge related to science education research.
	Special Skills	PLO 5	Design, implement, and evaluate science learning using ICT.
		PLO 6	Design and conduct research about learning of integrated science, and acquire, analyze, and interpret the research data.
Social competences	**General Skills**	PLO 7	Communicate ideas and research results effectively both in oral and written forms.
		PLO 8	Make decisions based on data / information in order to complete tasks and evaluate the performance that has been done.
		PLO 9	Work effectively both individually and in groups, and have entrepreneurial spirits and environmental awareness.
	Attitude	PLO 10	Demonstrate scientific, critical, and innovative attitudes in integrated science

Competency SSC-ASIIN	Aspect	PLO	DESCRIPTION
			learning, laboratory activities, and professional-related tasks.
		PLO 11	Demonstrate religious and cultural values as well as academic ethics in carrying out their professional-related duties.

Regard to the aspects of connection between PLO and PEO, Table 3 gives an overview how strong each of PLOs supports the PEO.

Table 3. Correlation between the PEOs and PLOs of UPSE

PLO	PEO				
	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5
PLO 1	S	S	S	M	M
PLO 2	S	S	S	M	M
PLO 3	S	S	S	M	S
PLO 4	M	S	S	M	S
PLO 5	S	S	S	M	S
PLO 6	S	S	S	S	S
PLO 7	S	M	S	S	S
PLO 8	S	S	S	S	S
PLO 9	S	S	S	S	S
PLO 10	S	M	S	S	S
PLO 11	M	M	M	M	S

S-Strong, M-Moderate

PROGRAM STRUCTURE

Similar to the formulation of PEOs, the current curriculum of UPSE was formulated based on the inputs from stakeholders, alumni, and science education experts. In addition, the current national curriculum for middle school (K13 curriculum), National Science Education Standards (NSES) 1996 were also considered to develop the current curriculum of UPSE. Furthermore, Indonesian National Qualification Framework (KKNI) for Bachelor Degree and National Standard for Higher Education in Indonesia (SN DIKTI) were reviewed to identify essential competencies for graduates of UPSE. Those aspects then were used to identify the important content knowledge and skills for educators for middle school students. Using the information, course subjects of UPSE were proposed and organized in curriculum structure. The proses of curriculum development is summarized in Figure 1.

Furthermore, the development of UPSE curriculum was conducted by adopting five principles of UNESA curriculum development. The five principles includes relevancy, flexibility, continuity, efficiency, and effectiveness. UPSE curriculum is relevant to social needs because it was developed based on national standard (e.g., KKNI, SN DIKTI) and international standards (e.g., NSES 1996) and the input from alumni, experts, and stakeholders. In other words, the UPSE curriculum is preparing the graduates to meet users' requirements. UPSE curriculum is also flexible as it is always adjusted to the current national issues in education, such as K13 curriculum. Continuity of UPSE curriculum is illustrated in Figure 3 and Roadmap PLO. Figure 3 shows that one course subject may support one or more other subjects from the same or

different disciplines indicating the relationship among the parts of the curriculum. To improve efficiency and effectiveness of UPSE curriculum, all relevant aspects (see Figure 1) were considered and combined to achieved the proposed PEOs.

The proposed curriculum structure as well as the course syllabus have been revised and applied within the period of 2015 - 2020. Continuous evaluation of the implementation of the UPSE's curriculum is conducted annually.

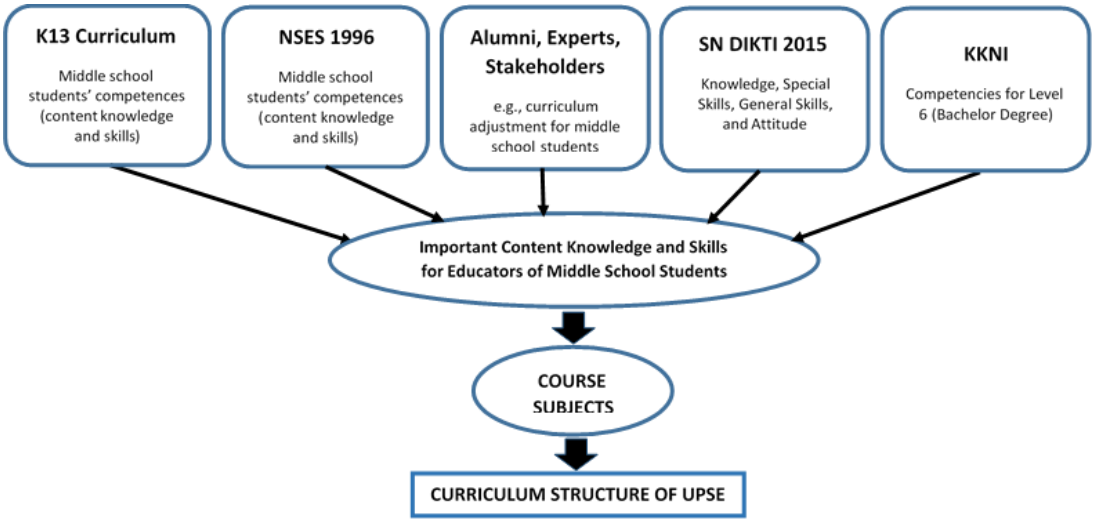


Figure 1. The development process of curriculum structure of UPSE

The curriculum of UPSE is delivered in 4 phases/years through 3 main structures: basic knowledge, interdisciplinary knowledge and pedagogical knowledge, as shown in Figure 2. In this structure, the learning process to gain the main competencies is modelled as a house. Basic and interdisciplinary knowledge are the foundation or the main requirement for students to learn pedagogical knowledge which is represented as the pillars of the house. Both basic and interdisciplinary knowledge function as pedagogical content knowledge. Without the content knowledge, pedagogical knowledge is meaningless. As a student mastery both content and pedagogical knowledge, they are expected to have competencies of science educators or teachers as the roof which cover all science education knowledge.

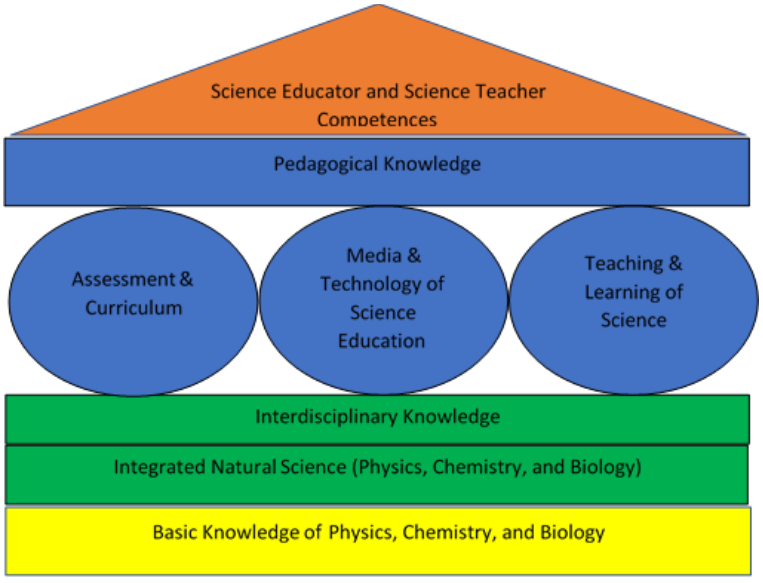


Figure 2. Model of curriculum structure of UPSE

The minimum workload of UPSE is 144 Credit Units (CU) which correspond to 5,712.48 hours[1] or 228.96 ECTS[2], and are generally distributed in 8 regular semesters. On average, the total hour per semester is 714.06 hours. The normal workload for each regular semester is limited to 872.74 hours, corresponds to 22 CU (34.98 ECTS). The detailed curriculum structure of UPSE in relation to PLOs is shown in Table 4.

Table 4. Mapping of the courses that support PLOs of UPSE

No	Code	Course Title	CU	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
Semester I														
1	1000002020	Pancasila Education	2									√		√
2	8420103012	English	3							√				
3	8420103045	General Physics	3	√	√									
4	8420103074	General Chemistry	3	√	√									
5	8420103023	General Biology	3	√	√									
6	1000002003	Indonesia Language	2							√				
7	8420103086	Basic Mathematics	3	√	√									
8	1000003006	Introductory of Education	3			√								
Total			**22 CU (34.98 ECTS)**											
Semester II														
9	1000002026	Religion Education	2											√
10	1000002033	Citezenship Education	2									√		√
11	8420102183	Digital Literacy	2					√						
12	8420103088	Mathematics for Science	3	√	√									
13	1000002039	Educational Psychology	2			√								
14	8420102028	Introductory of Natural Science	2	√	√									
15	8420103155	Learning Theory	3			√								
16	8420102032	Basic Computer	2				√							
17	8420103065	Biodiversity	3	√	√									
Total			**21 CU (33.39 ECTS)**											
Semester III														
18	8420102159	History and Philosophy of Science Education	2				√					√		
19	8420103154	Curriculum Review	3			√								
20	8420102176	Entrepreneurship	2											
21	8420102060	Social and Culture Study	2							√	√			√
22	8420103053	Biomechanics	3		√									
23	8420103162	Plant Anatomy and Physiology	3		√									
24	8420103158	Matters and Energy	3		√									
25	8420103161	Management and Safety Work in Laboratory	3								√		√	
Total			**21 CU (33.39 ECTS)**											
Semester IV														
26	8420103107	Innovative Learning I	3			√		√						
27	8420103167	Animal Anatomy and Physiology	3		√									
28	8420103048	Fluids	3		√									

[1] Referring to UNESA Academic Guideline 2019, 1 CU for bachelor degree or 1 *sks* equals to 170 minutes per week. For one semester, each course is conducted in 14 weeks (excluding mid- and end-term exam). Thus, 1 CU equals to 14 weeks × 170 minutes = 2,380 minutes or 39.67 hours.

[2] 1 CU equals to 1.59 ECTS, assuming that 1 ECTS equals to 25 work hours per semester (according to The Decree of Rector Unesa No. 598/UN38/HK/AK/2019 dated June 6th, 2020).

No	Code	Course Title	CU	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
29	8420102076	Conservation of Natural Resources and Environment	2	√							√			
30	8420103163	Introductory of Biochemistry	3		√									
31	8420103090	Learning Media	3			√		√						
32	8420103010	Assessment and Evaluation	3			√		√						
Total			**20 CU (31.80 ECTS)**											
Semester V														
33	8420103109	Innovative Learning II	3			√		√						
34	8420103138	SETS	3		√									
35	8420103033	Ecology	3		√									
36	8420103081	Solution	3	√										
37	8420103067	Live at Cellular Level	3		√									
38	8420103068	Electricity and Magnetism	3		√									
39	8420103094	Research Method	3			√		√	√					
Total			**21 CU (33.39 ECTS)**											
Semester VI														
40		Elective Course*)	2	√										
41	8420103168	Statistics of Education	3						√					
42	8420102005	Science School Analysis	2	√										
43	8420103049	Wave and Optics	3		√									
44		Elective Course*)	2		√									
45	8420102142	Seminar	2			√		√	√				√	√
Total			**14 CU (22.26 ECTS)**											
Semester VII														
46		Elective Course*)	2		√									
47	8420103178	Community Service	3									√		√
48		Elective Course*)	2											
49		Elective Course*)	3											
50	8420104182	Internship	4		√		√	√			√		√	
Total			**14 CU (22.26 ECTS)**											
Semester VIII														
51	8420106146	Thesis	6			√		√	√				√	√
52		Elective Course*)	3											
53		Elective Course*)	2											
Total			**11 CU (17.49 ECTS)**											
Total			**144 CU (228.96 ECTS)**											

Table 5. Compulsory and elective courses in UPSE

Courses	CU	Note
Compulsory	128	The 128 CU are distributed into 46 compulsory courses including university compulsory courses.
Elective	16	There are 16 available CU which are distributed into 7 elective courses and students should take at least 16 CU.
Total	**144**	

Table 6. UNESA compulsory courses

No.	Code	Course Name	CU
1	1000002026	Religion Education	2
2	1000002030	Pancasila Education	2
3	1000002018	Digital Literacy	2
4	1000002033	Citezenship Education	2
5	1000002039	Educational Psychology	2
6	1000002003	Indonesia Language	2
Total			12

Table 7. Elective courses in UPSE

No.	Code	Course Name	CU
1	8420102029	Introductory of Biotechnology	2
2	8420103038	Ethno-science	3
3	8420102073	Household Chemistry	2
4	8420103171	Atom and Radioactivity	2
5	8420103064	Review of Science Research findings	2
6	8420103170	Introductory of Electronics	2
7	8420103123	Earth and Planetary Science	3
Total			16

The relationship among courses within the curriculum structure of UPSE is illustrated in curriculum roadmap as shown in Figure 3. The roadmap also portrays the paths that undergraduates have to go through to acquire three essential knowledge as shown in Figure 2. Furthermore, the roadmap represents explicitly the integration of science components (physics, chemistry, and biology) within the curriculum of UPSE.

In the first year of study, students who enrolled in UPSE are obliged to attend courses which provide basic knowledge of natural science and education. The courses include Introductory of Natural Science, General Physics, General Chemistry, General Biology, Mathematics of Science, Introductory of Education, Educational Psychology and Learning Theory. Within this year, students learn natural science components (physics, chemistry, and biology) separately. These basic courses give foundations for students to learn advance subjects or interdisciplinary knowledge in the following semesters. In order to support students' development of interpersonal capability, moreover, students need to enroll in other courses, such as Religion Education, Pancasila Education, English, Indonesia Language, Digital Literacy and Basic Computer.

Starting from the third semester, students of UPSE begin to learn interdisciplinary knowledge through courses which integrate two or more natural science components, such as Biomechanics, Fluid, and Introductory of Biochemistry. Other courses, indeed, integrate natural science with other field, such as technology (Introductory of Biotechnology; SETS) and culture (Ethno-science). While learning some interdisciplinary knowledge, students also learn

in depth essential components of pedagogical knowledge through four separate courses including Curriculum Review, Innovative Learning, Learning Media, and Assessment and Evaluation. The students are further encouraged to apply their science and pedagogical knowledge and skills in practice-oriented courses, such as Research Methods, Microteaching, and Seminar. The Research Methods and Seminar are in series courses. The former requires students to create a research proposal in education, while the latter provides practices for students to communicate their created research proposal. Students' pedagogical knowledge and skills are developed and sharpened through Microteaching course. Moreover, the internship as the practice-based learning is also well-integrated into the program structure to provide students with useful experiences for their future professional life and for sharpening their knowledge and skills. The study program is concluded by taking final project worth 6 CU known as Thesis.

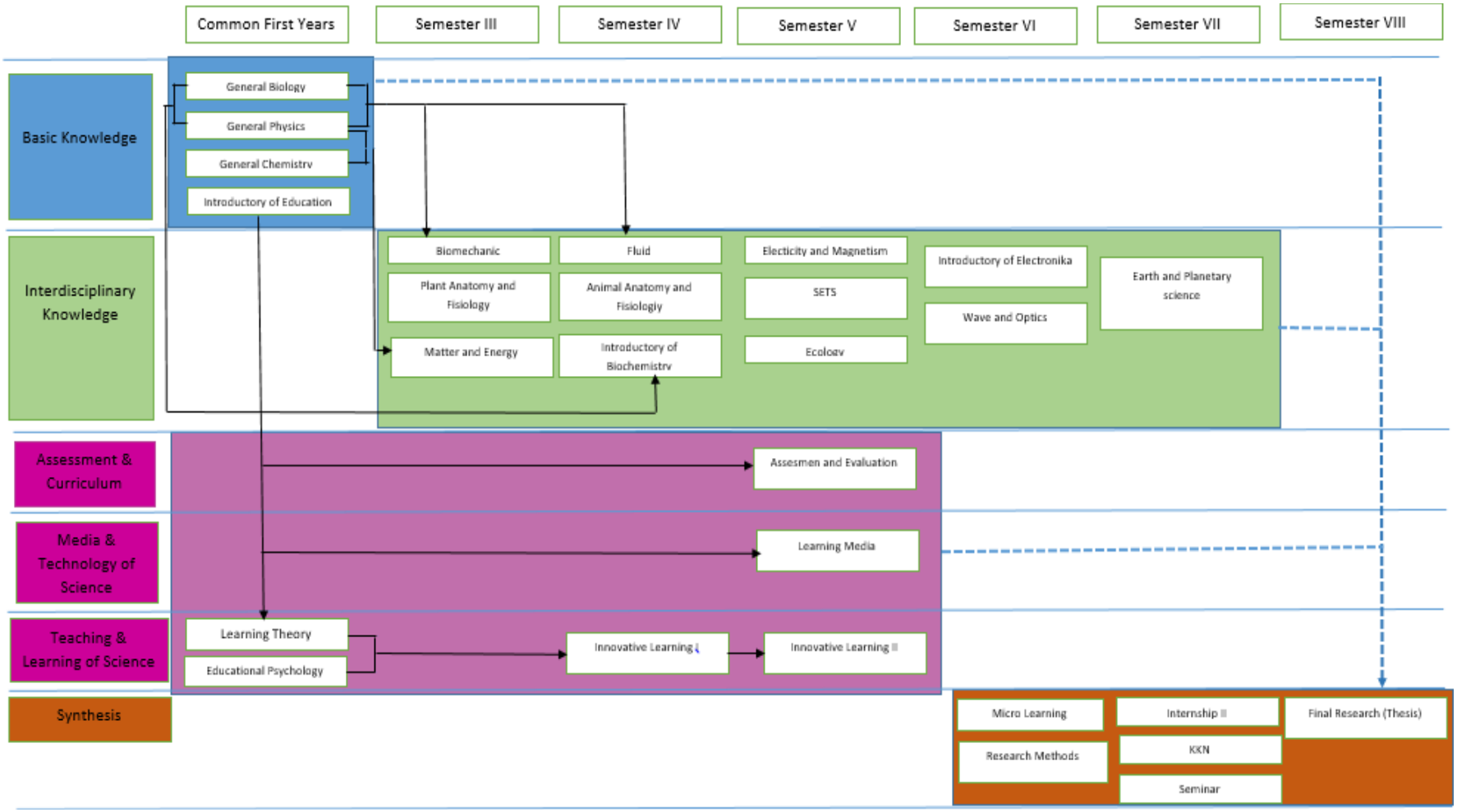
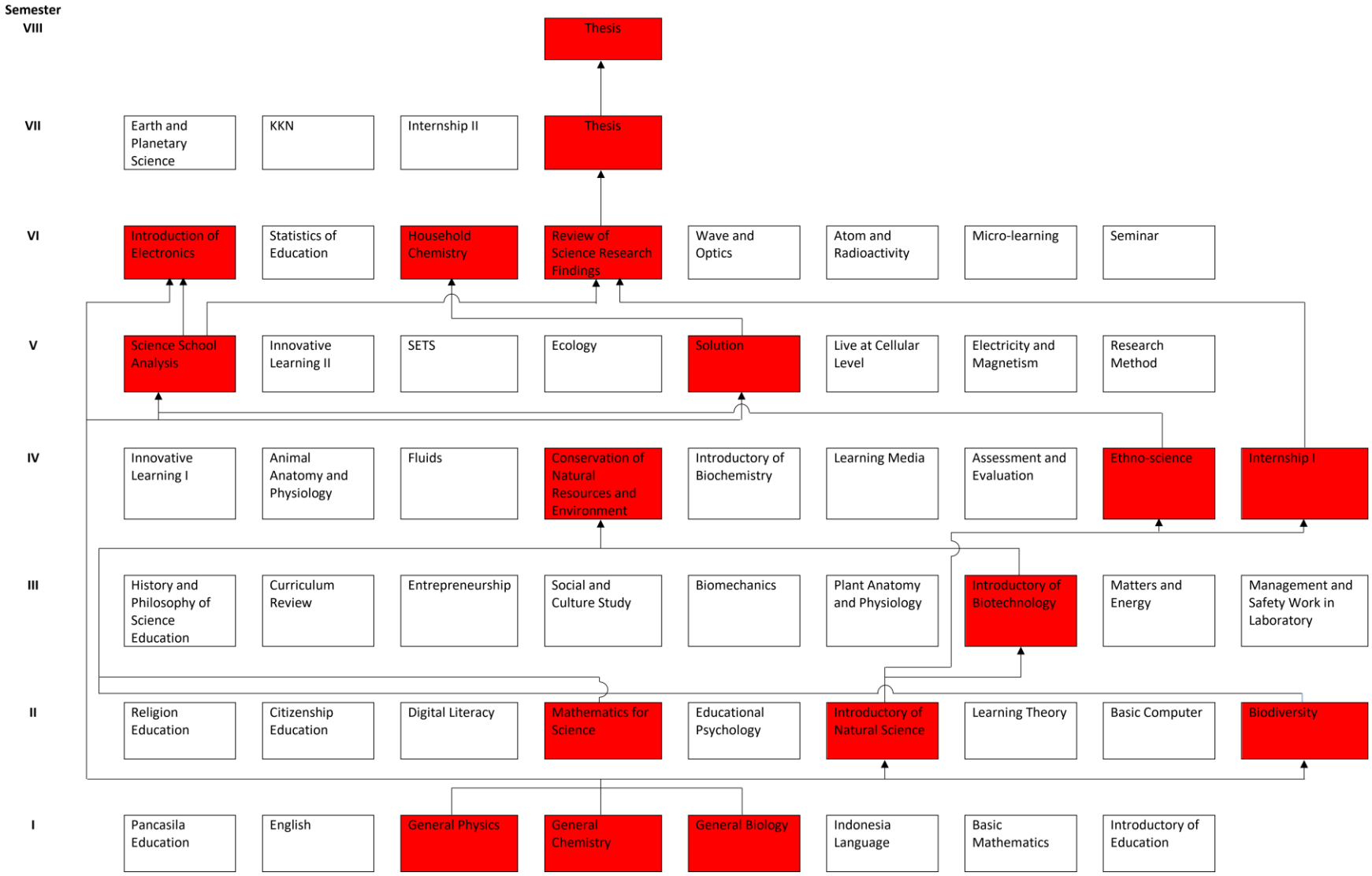
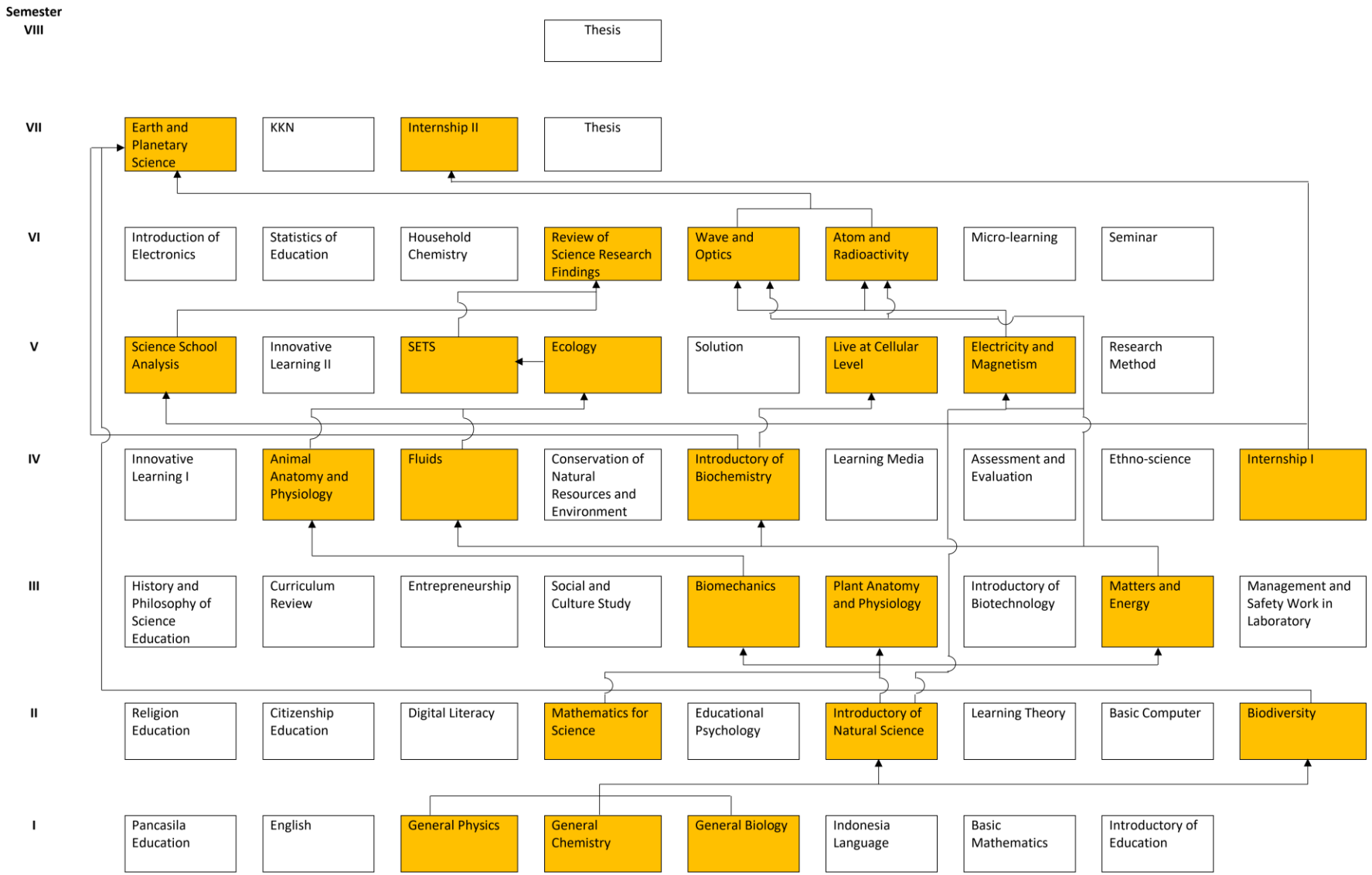


Figure 3. Curriculum Roadmap of UPSE

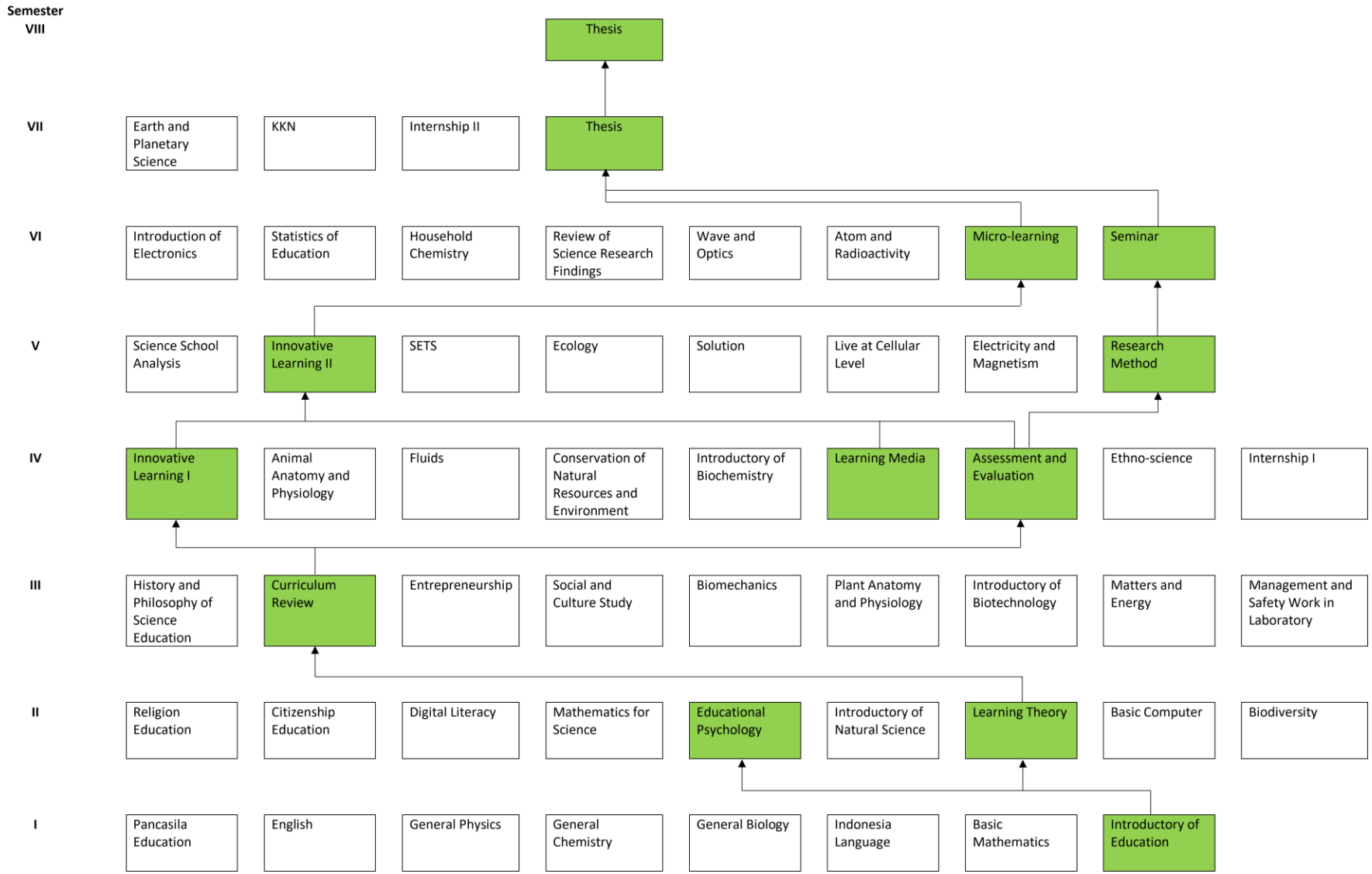
PLO 1 ROADMAP



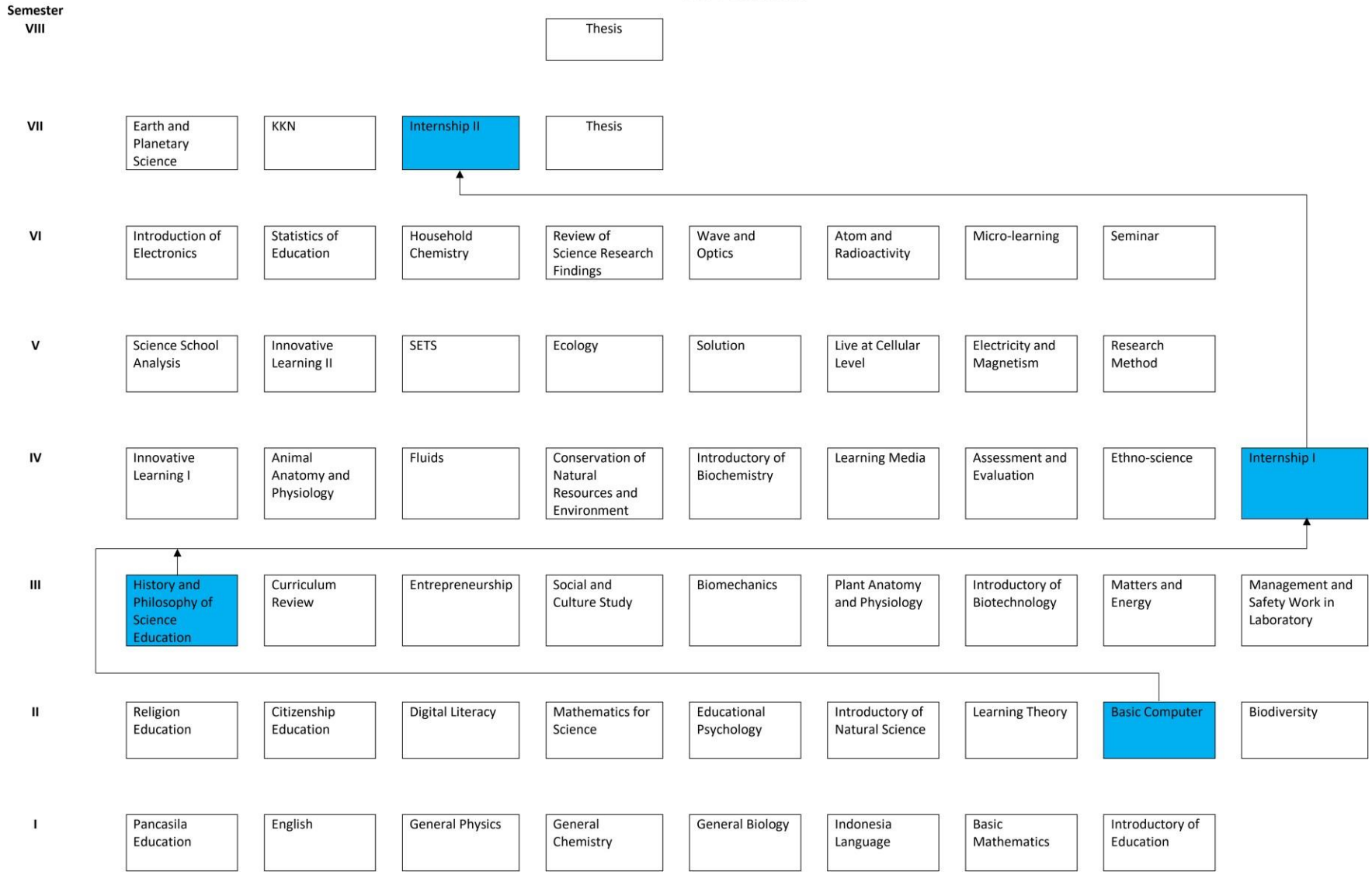
PLO 2 ROADMAP



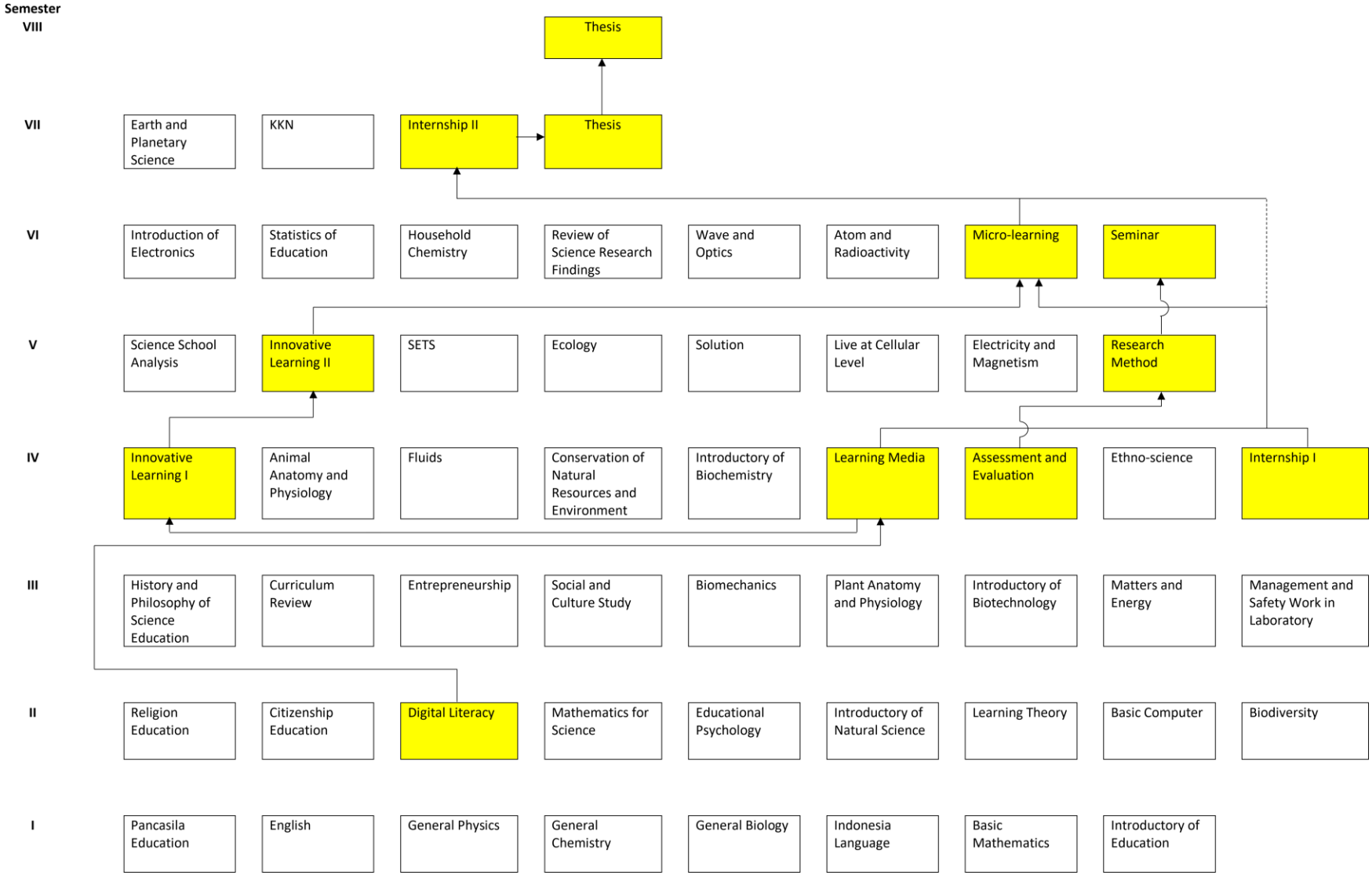
PLO 3 ROADMAP



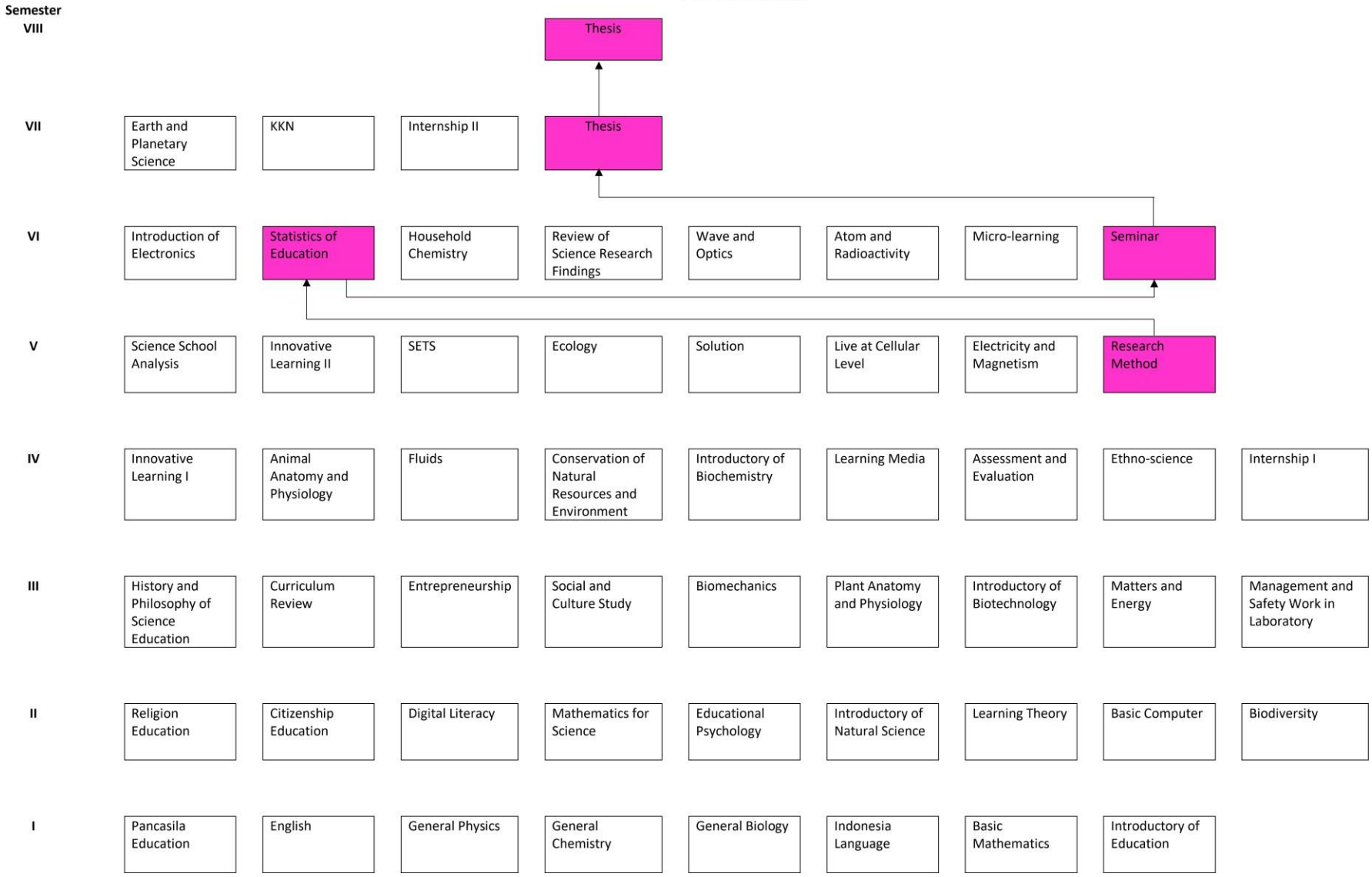
PLO 4 ROADMAP



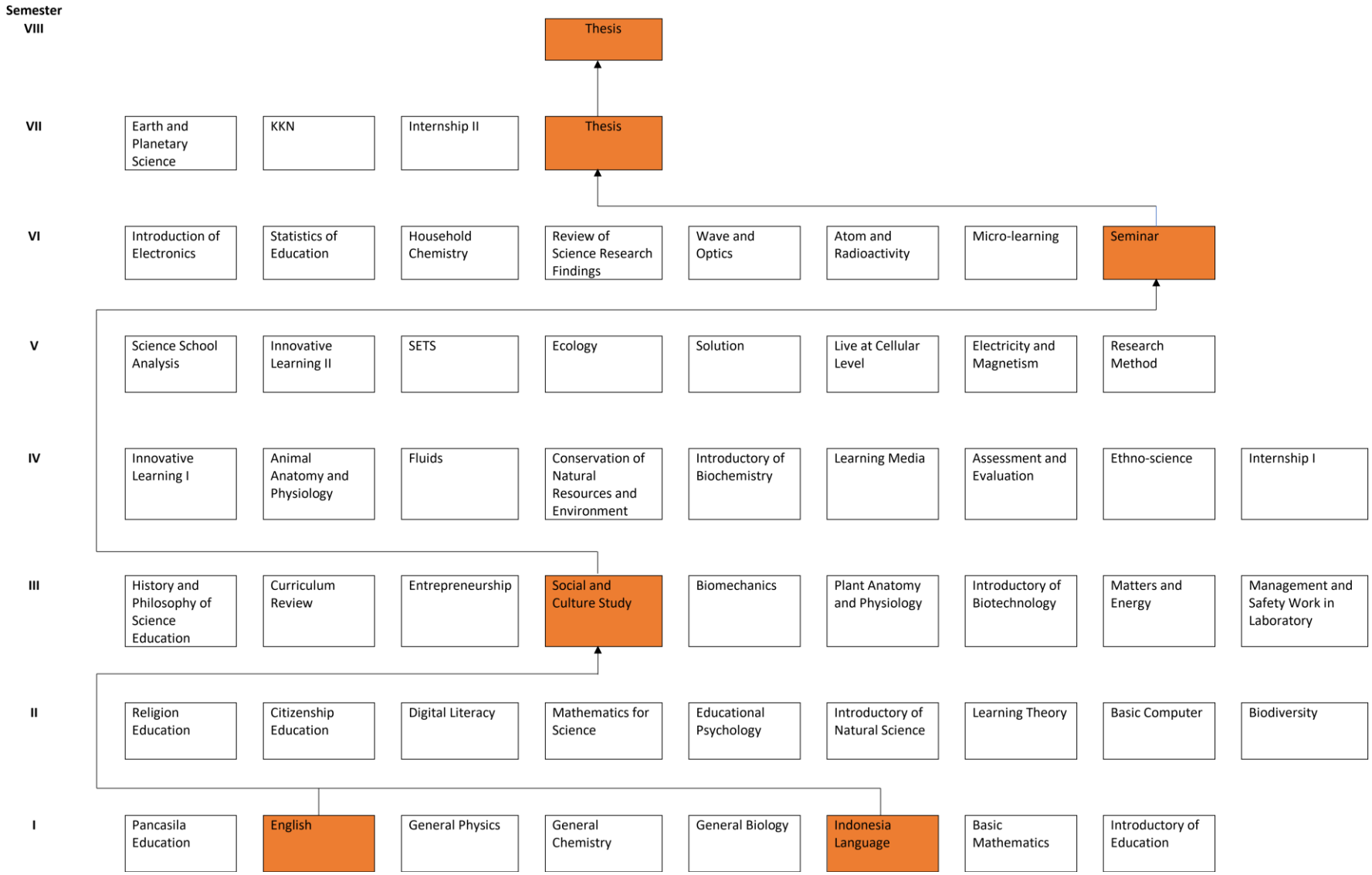
PLO 5 ROADMAP



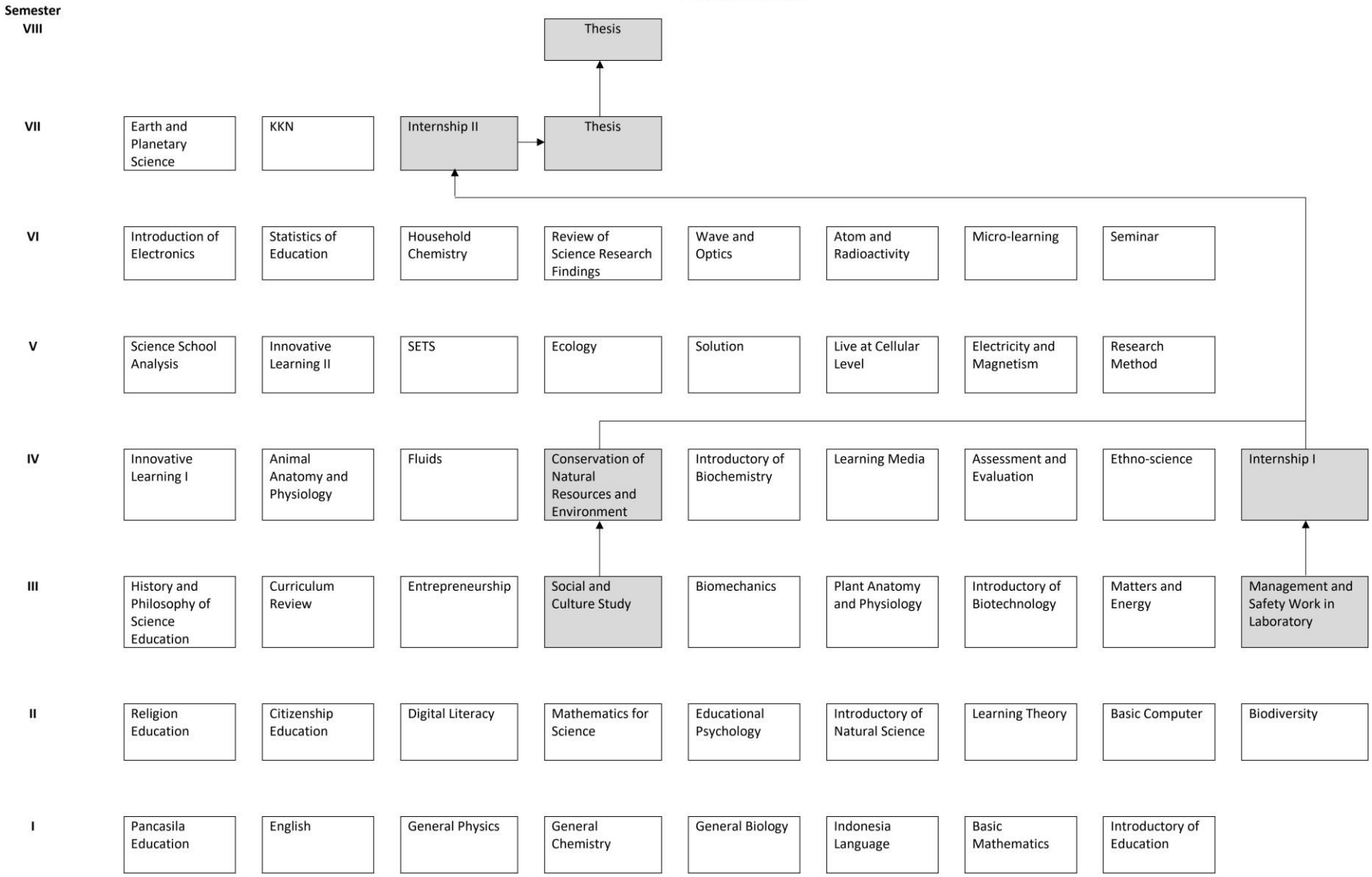
PLO 6 ROADMAP



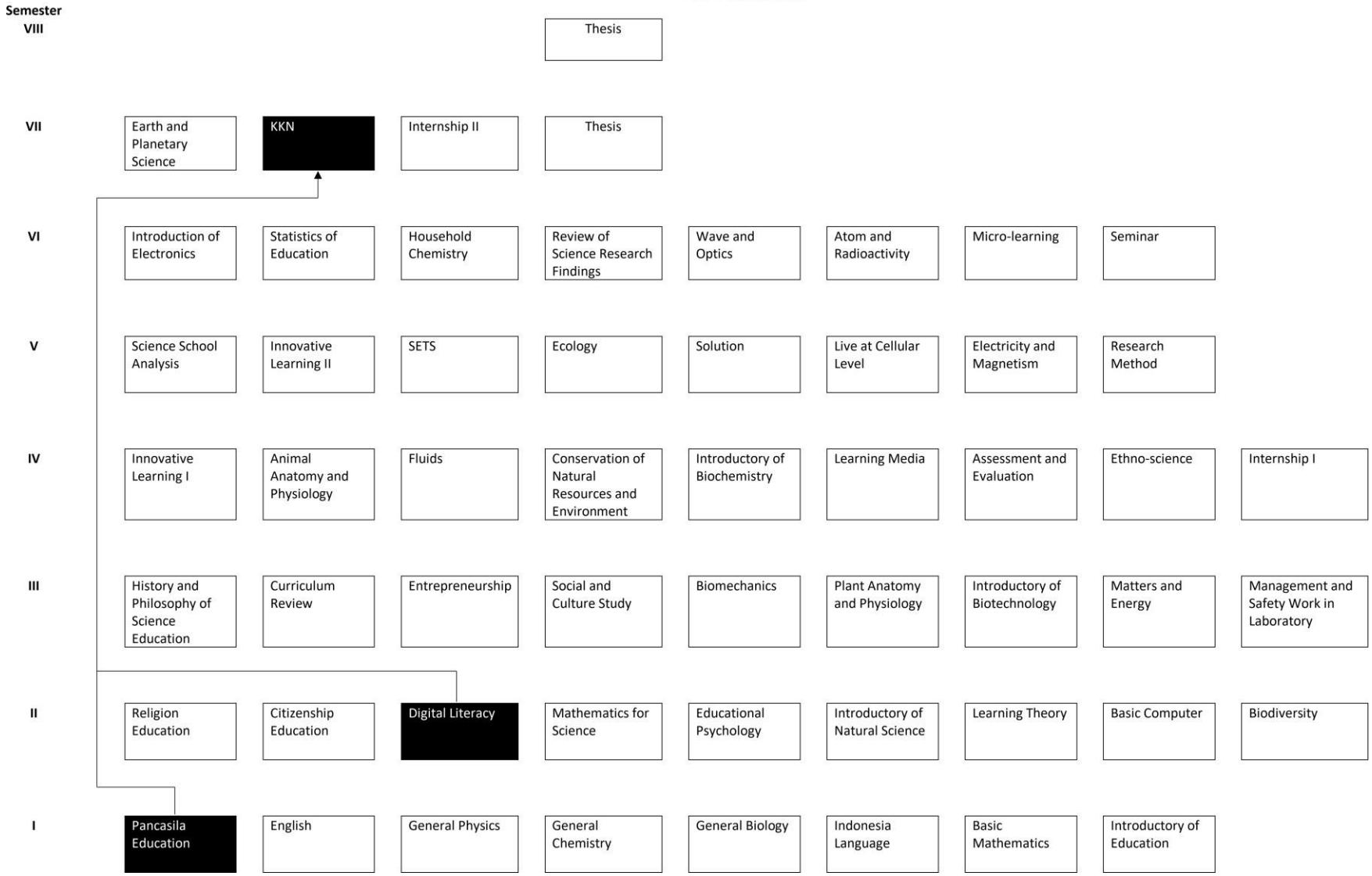
PLO 7 ROADMAP



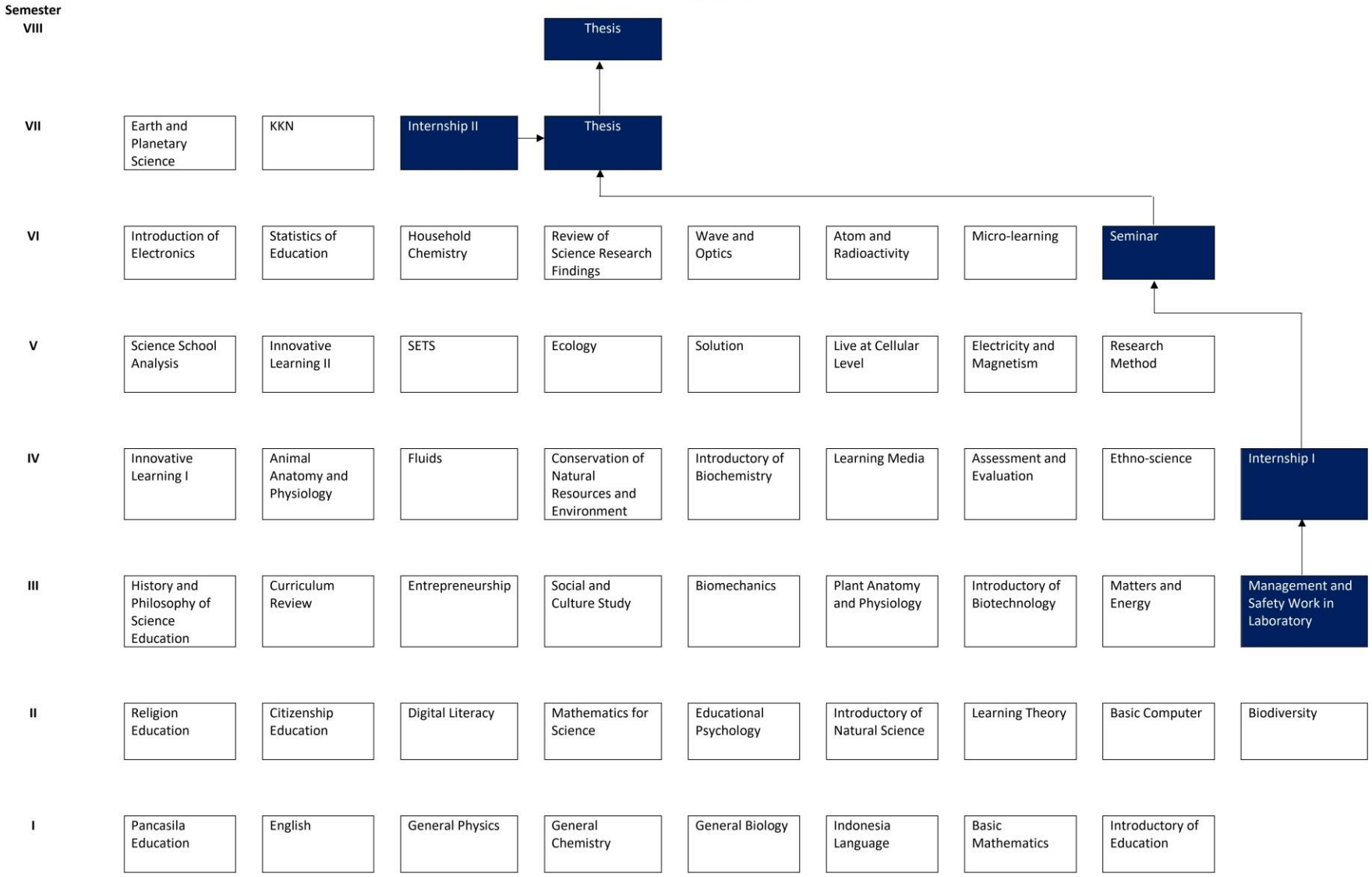
PLO 8 ROADMAP



PLO 9 ROADMAP



PLO 10 ROADMAP



PLO 11 ROADMAP

