# 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 6$^{th}$ 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.

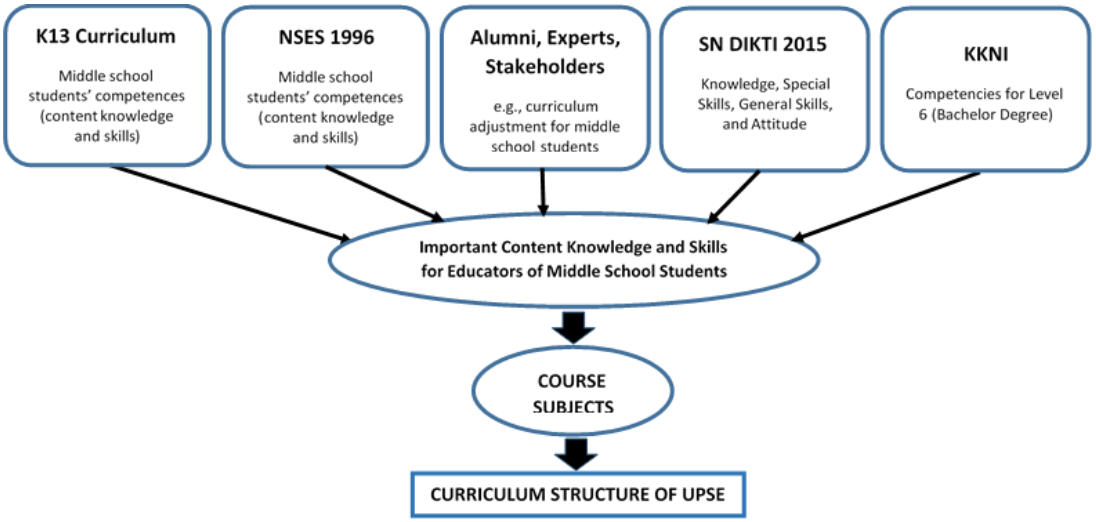



**Figure 1**. The development process of curriculum structure of UPSE

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.

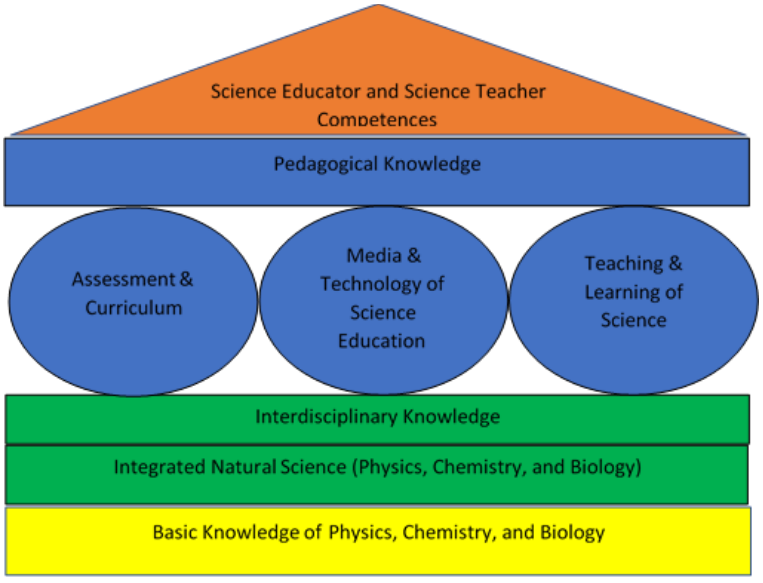



**Figure 2.** Model of curriculum structure of UPSE

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 | 2 | | | | | | | | | √ | | √ |
| 2 | 8420103012 | English | 3 | | | | | | | √ | | | | |
| 3 | 8420103045 | General Physics*) | 3 | √ | √ | | | | | | | | | |
| 4 | 8420103074 | General Chemistry*) | 3 | √ | √ | | | | | | | | | |
| 5 | 8420103023 | General Biology*) | 3 | √ | √ | | | | | | | | | |
| 6 | 1000002003 | Indonesian | 2 | | | | | | | √ | | | | |
| 7 | 8420103086 | Basic Mathematics*) | 3 | √ | √ | | | | | | | | | |
| 8 | 1000003006 | Basic of Education*) | 3 | | | √ | | | | | | | | |
| **Total** | | | **22 CU (34.98 ECTS)** | | | | | | | | | | | |
| Semester II | | | | | | | | | | | | | | |
| 9 | 1000002026 | Religion Education | 2 | | | | | | | | | | | √ |
| 10 | 1000002033 | Citizenship 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 Theories | 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 | Basic Social and Cultural Sciences | 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 | Life at Cellular Level*) | 3 | | √ | | | | | | | | | |
| 38 | 8420103068 | Electricity and Magnetism*) | 3 | | √ | | | | | | | | | |
| 39 | 8420103094 | Research Methodology*) | 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 | Teaching 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)** | | | | | | | | | | | |

Note: *) Integrated with practicum

**Table 5.** Compulsory and elective courses in the UPSE

| Courses | CU | ECTS | Note |
|---|---|---|---|
| Compulsory courses | 128 | 203.52 | The 128 CU are distributed into 46 compulsory courses including university compulsory courses. |
| Elective courses | 16 | 25.44 | There are 16 available CU which are distributed into 7 elective courses and students should take at least 16 CU. |
| Total | **144** | **228.96** | |

**Table 6**. UNESA compulsory courses

| No. | Code | Course Name | CU |
|---|---|---|---|
| 1 | 1000002026 | Religion Education | 2 |
| 2 | 1000002030 | Pancasila | 2 |
| 3 | 1000002018 | Digital Literacy | 2 |
| 4 | 1000002033 | Citizenship Education | 2 |
| 5 | 1000002039 | Educational Psychology | 2 |
| 6 | 1000002003 | Indonesian | 2 |
| **Total** | | | 12 |

**Table 7**. Elective courses in UPSE

| No. | Code | Course Name | CU |
|---|---|---|---|
| 1 | 8420102029 | Introductory of Biotechnology | 2 |
| 2 | 8420103038 | Ethnoscience*) | 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 |

Note: *) Integrated with practicum

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, Basic of Education, Educational Psychology and Learning Theories. 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, English, Indonesian, 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, Fluids, and Introductory of Biochemistry. Other courses, indeed, integrate natural science with other field, such as technology (Introductory of Biotechnology; SETS) and culture (Ethnoscience). 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 Methodology, and Seminar. Research Methodology 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. Moreover, Teaching 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. Students are also required to take a final project worth 6 CU known as Thesis.

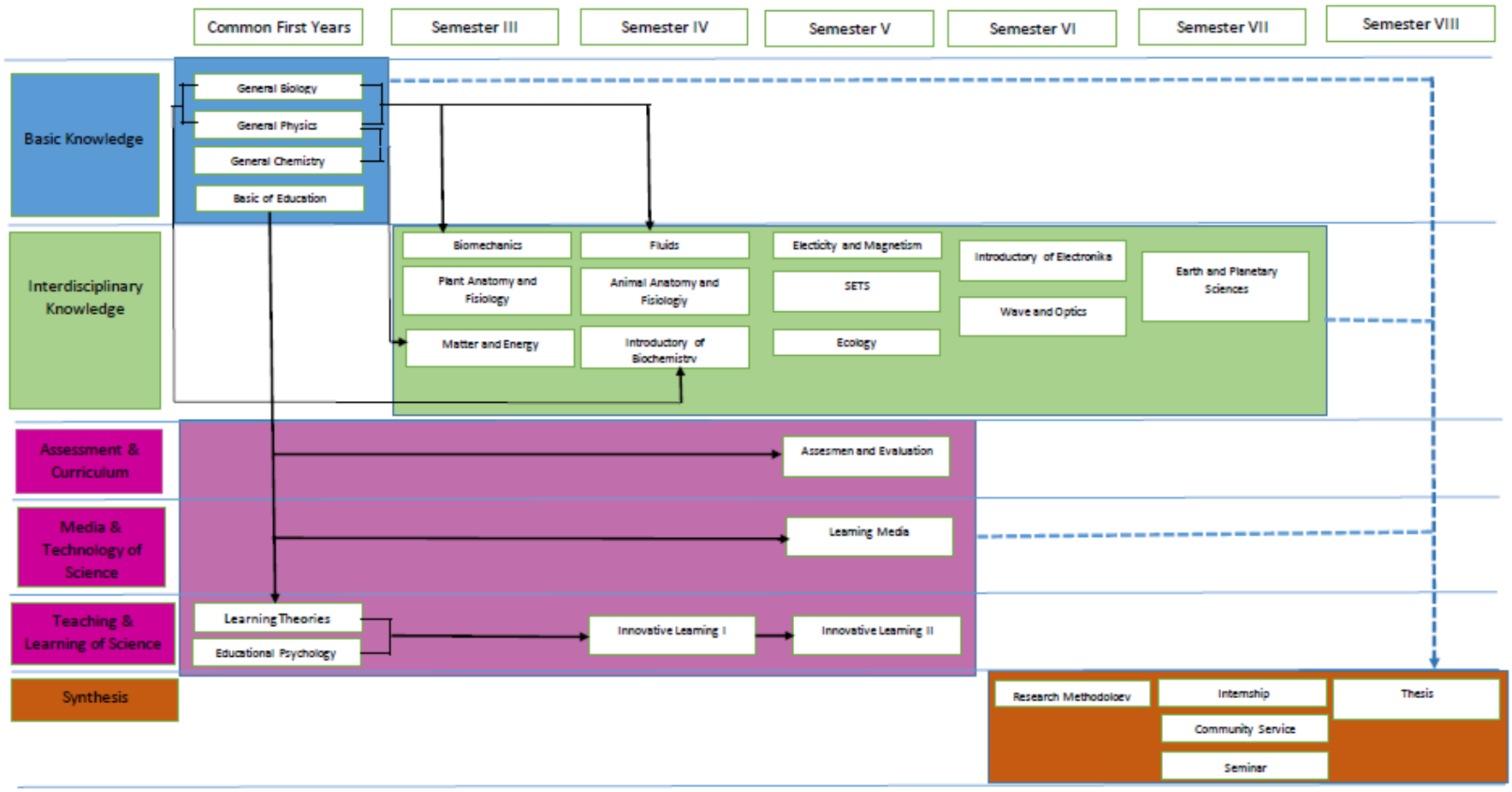
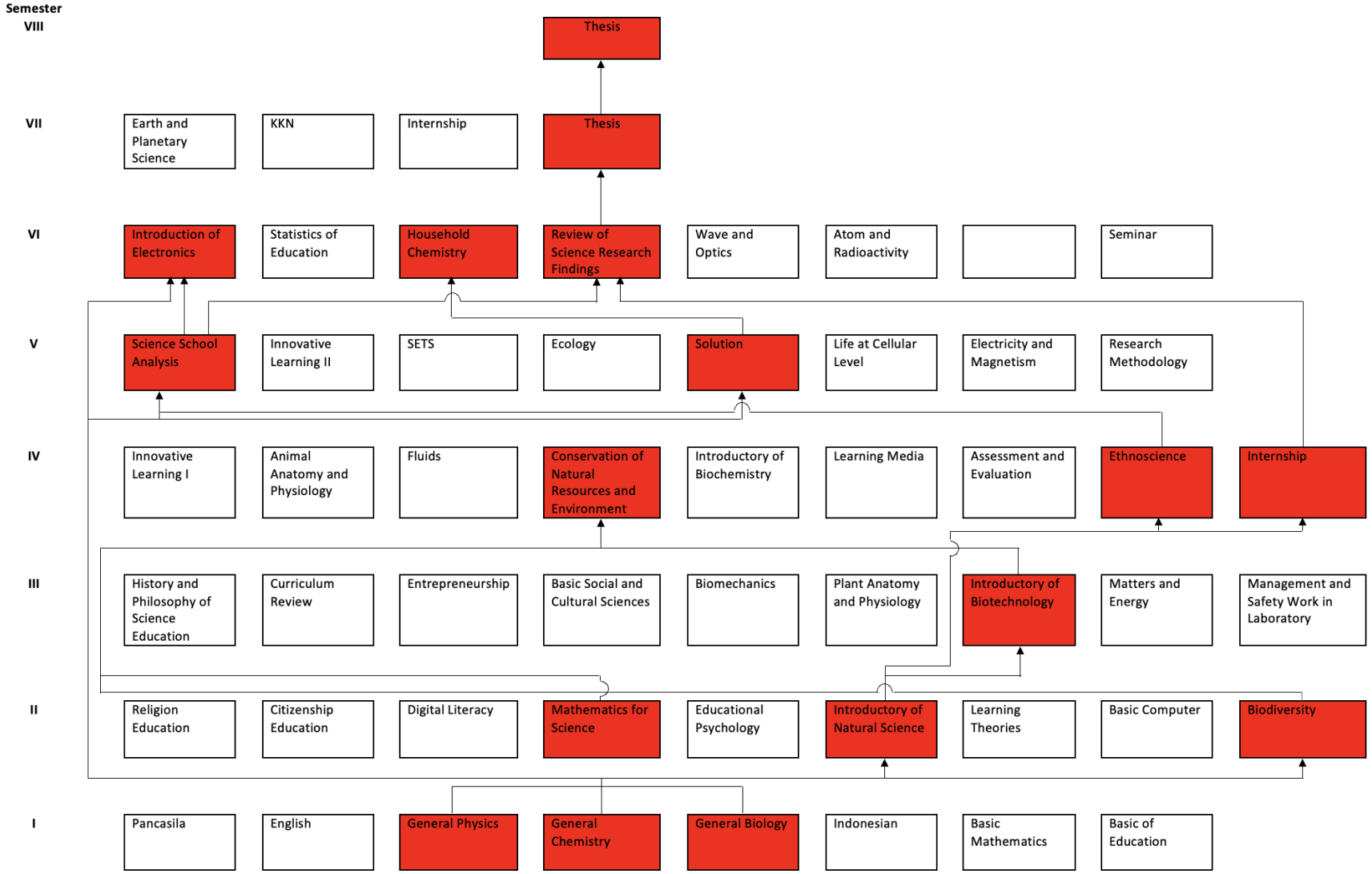
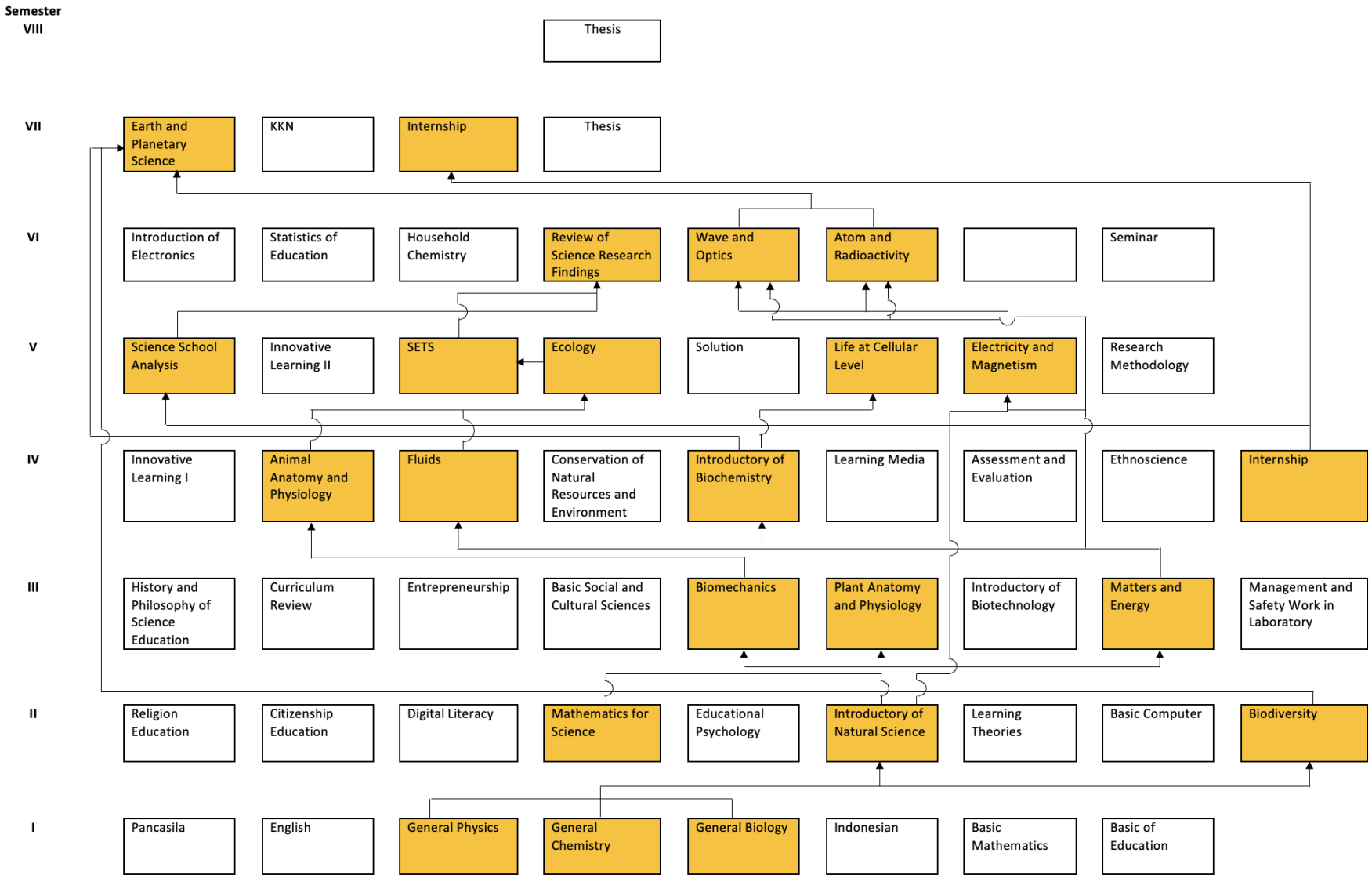



**Figure 3**. Curriculum Roadmap of UPSE

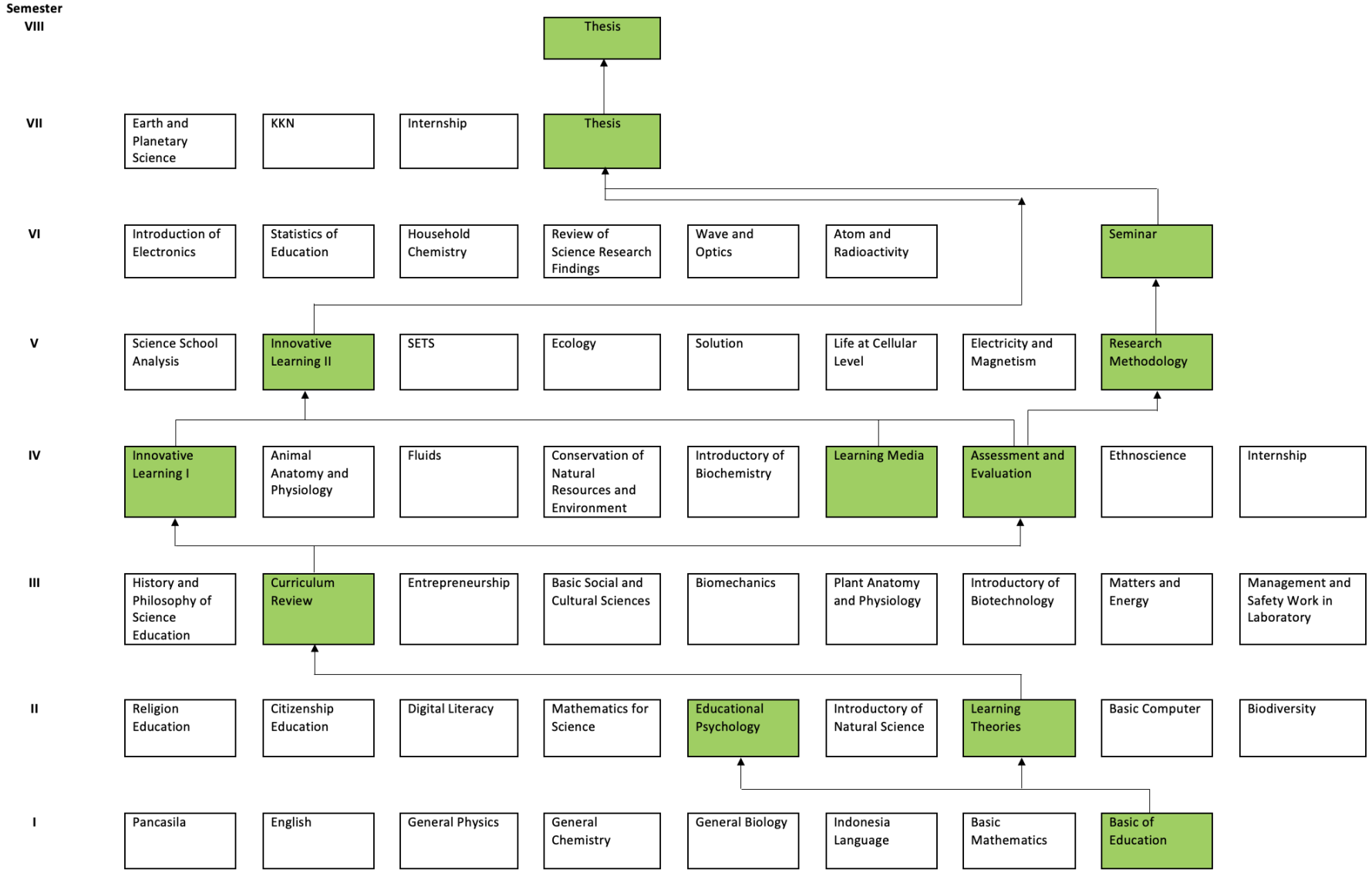
## PLO 1 ROADMAP



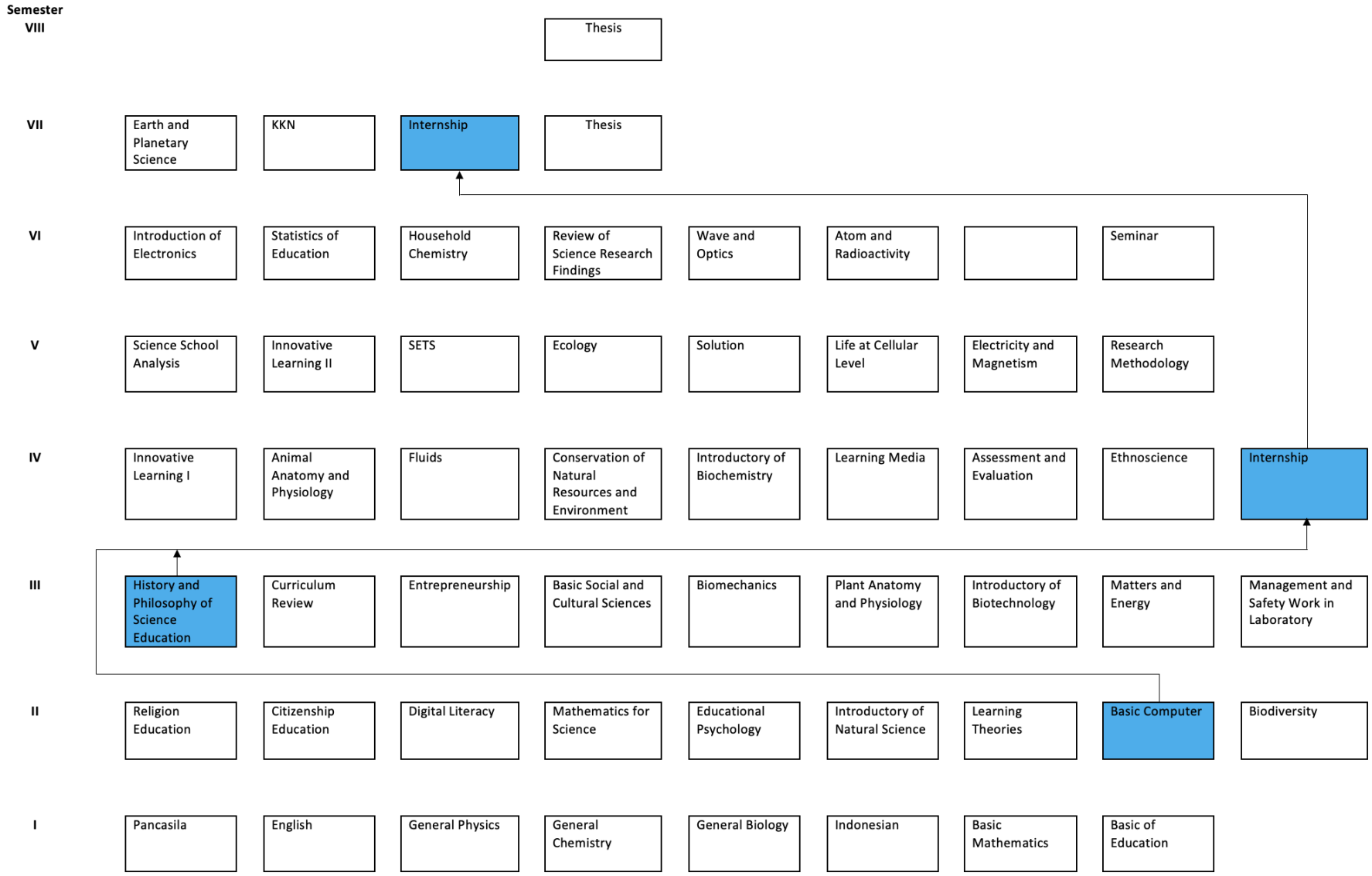
## PLO 2 ROADMAP



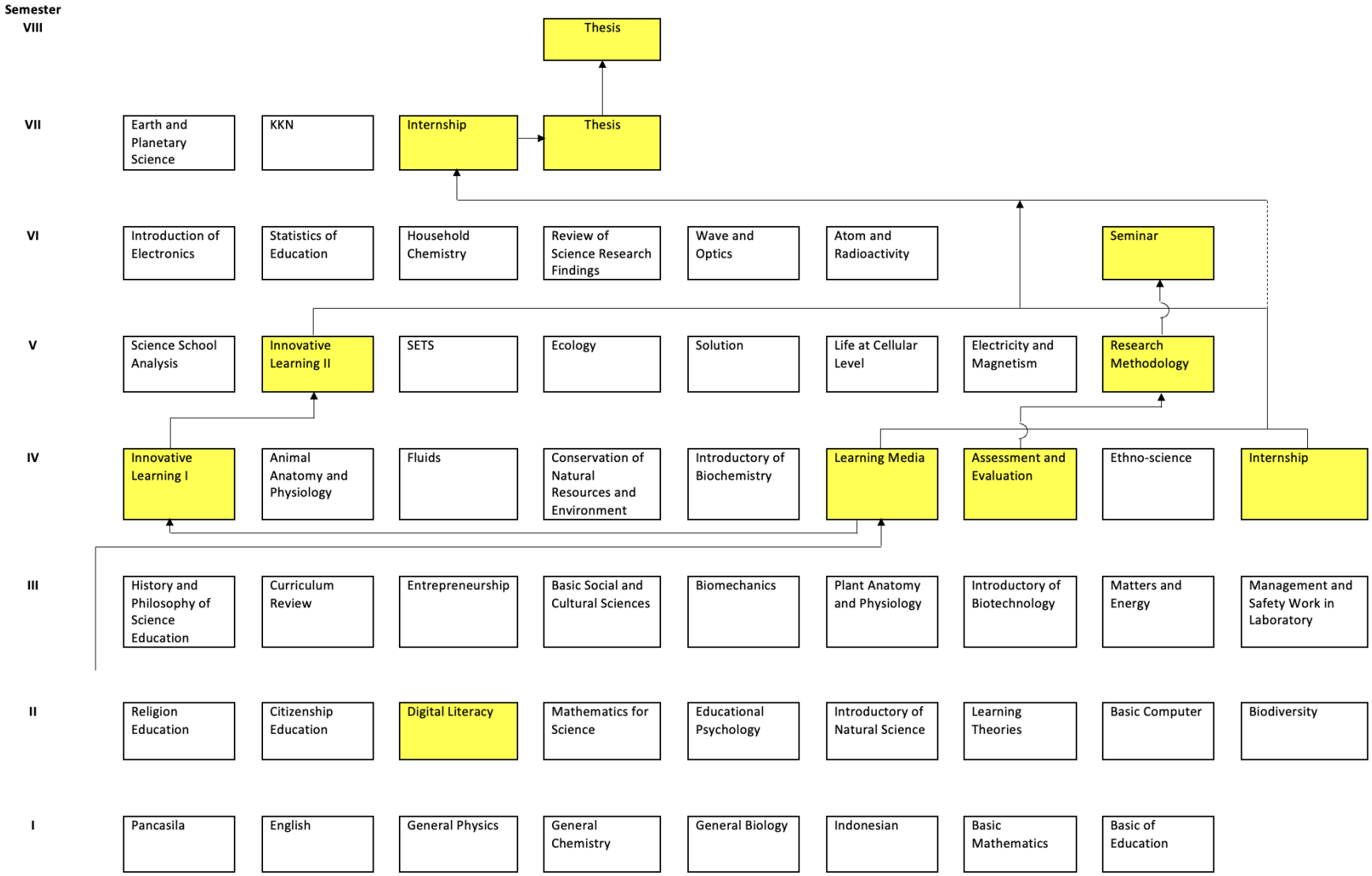
## PLO 3 ROADMAP



## PLO 4 ROADMAP



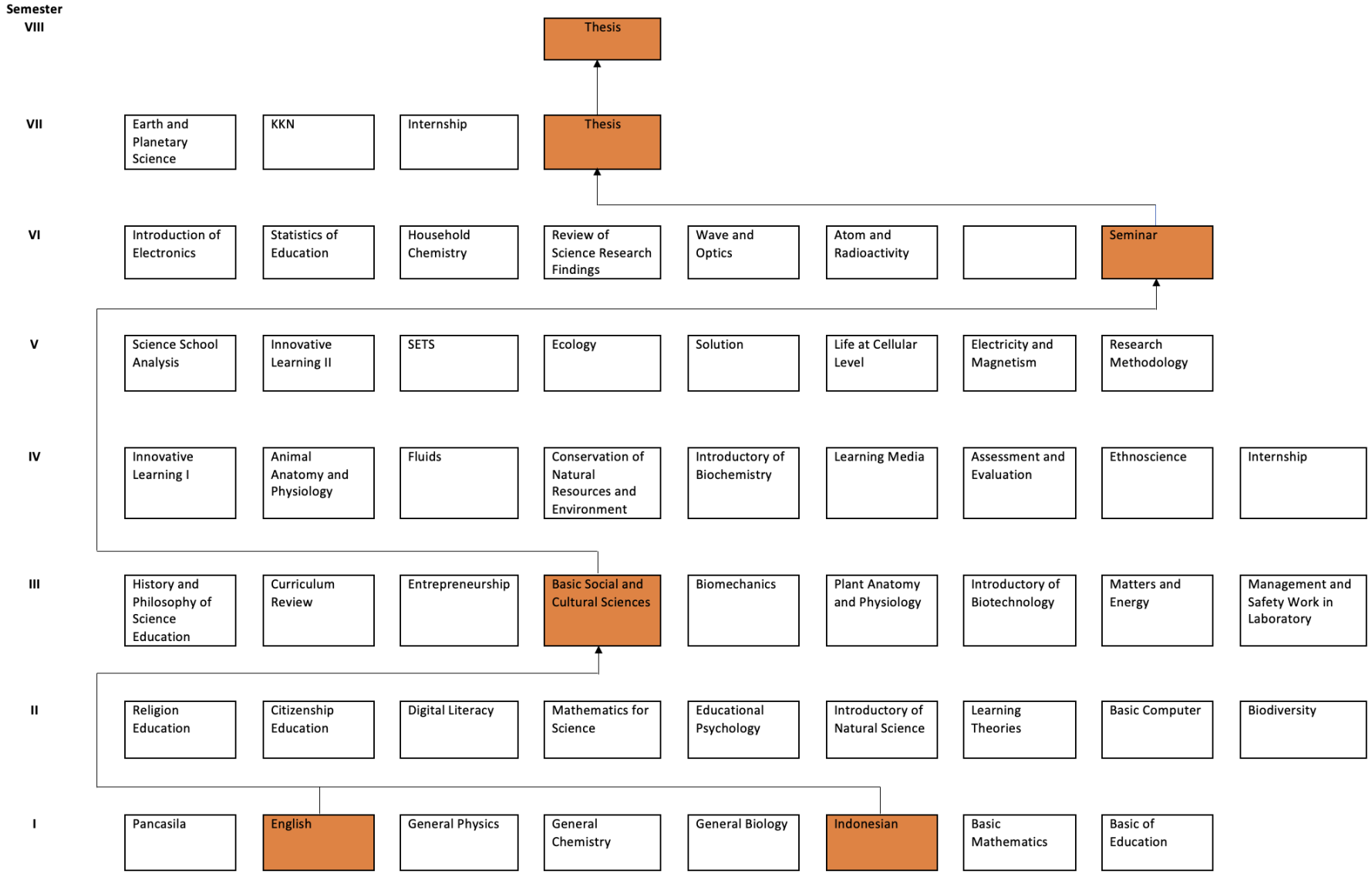
## PLO 5 ROADMAP



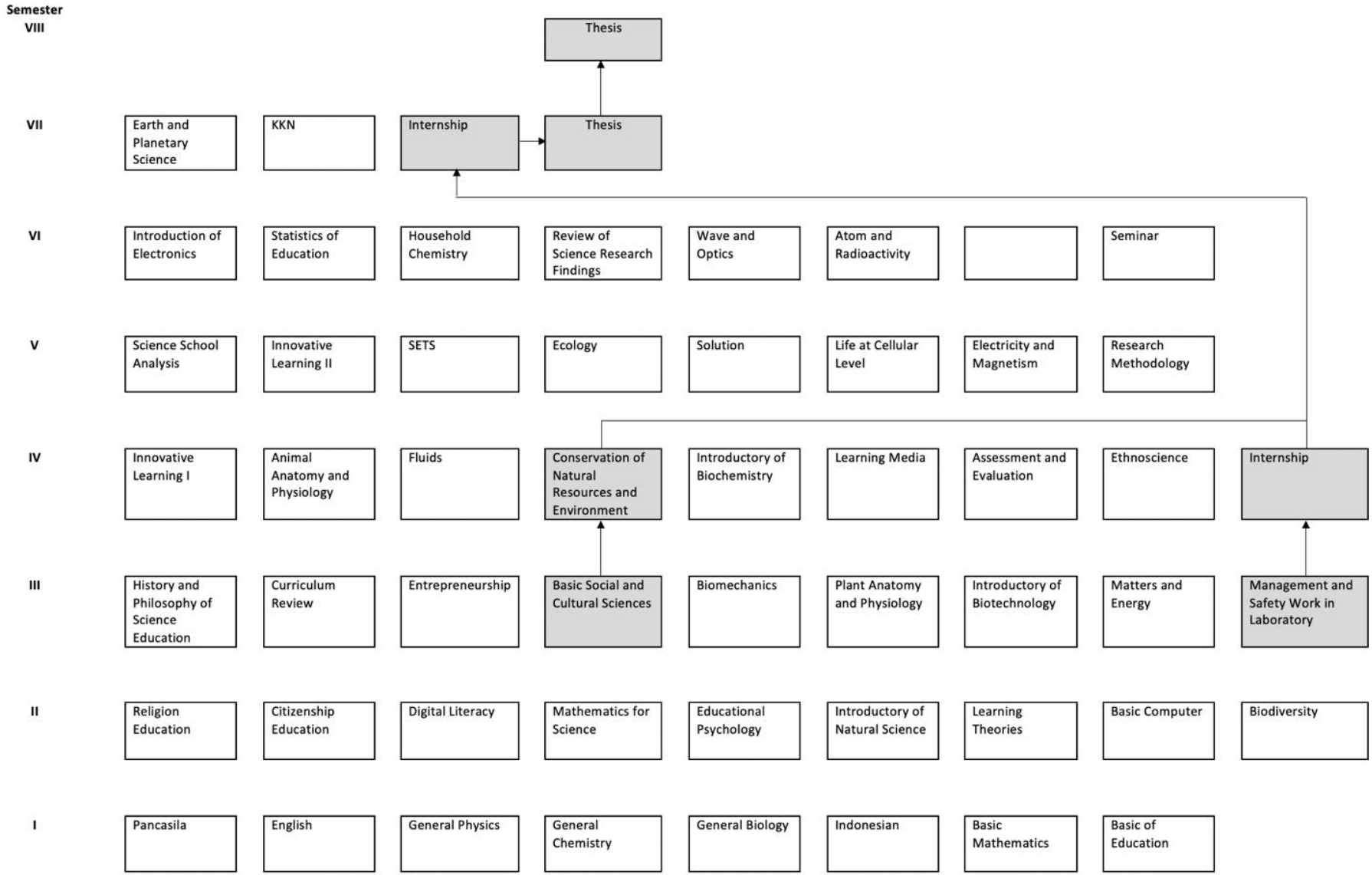
**PLO 6 ROADMAP**

| Semester | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VIII | | | | Thesis | | | | | |
| VII | Earth and Planetary Science | KKN | Internship | Thesis | | | | | |
| VI | Introduction of Electronics | Statistics of Education | Household Chemistry | Review of Science Research Findings | Wave and Optics | Atom and Radioactivity | | Seminar | |
| V | Science School Analysis | Innovative Learning II | SETS | Ecology | Solution | Life at Cellular Level | Electricity and Magnetism | Research Methodology | |
| IV | Innovative Learning I | Animal Anatomy and Physiology | Fluids | Conservation of Natural Resources and Environment | Introductory of Biochemistry | Learning Media | Assessment and Evaluation | Ethnoscience | Internship |
| III | History and Philosophy of Science Education | Curriculum Review | Entrepreneurship | Social and Culture Study | Biomechanics | Plant Anatomy and Physiology | Introductory of Biotechnology | Matters and Energy | Management and Safety Work in Laboratory |
| II | Religion Education | Citizenship Education | Digital Literacy | Mathematics for Science | Educational Psychology | Introductory of Natural Science | Learning Theories | Basic Computer | Biodiversity |
| I | Pancasila | English | General Physics | General Chemistry | General Biology | Indonesian | Basic Mathematics | Basic of Education | |

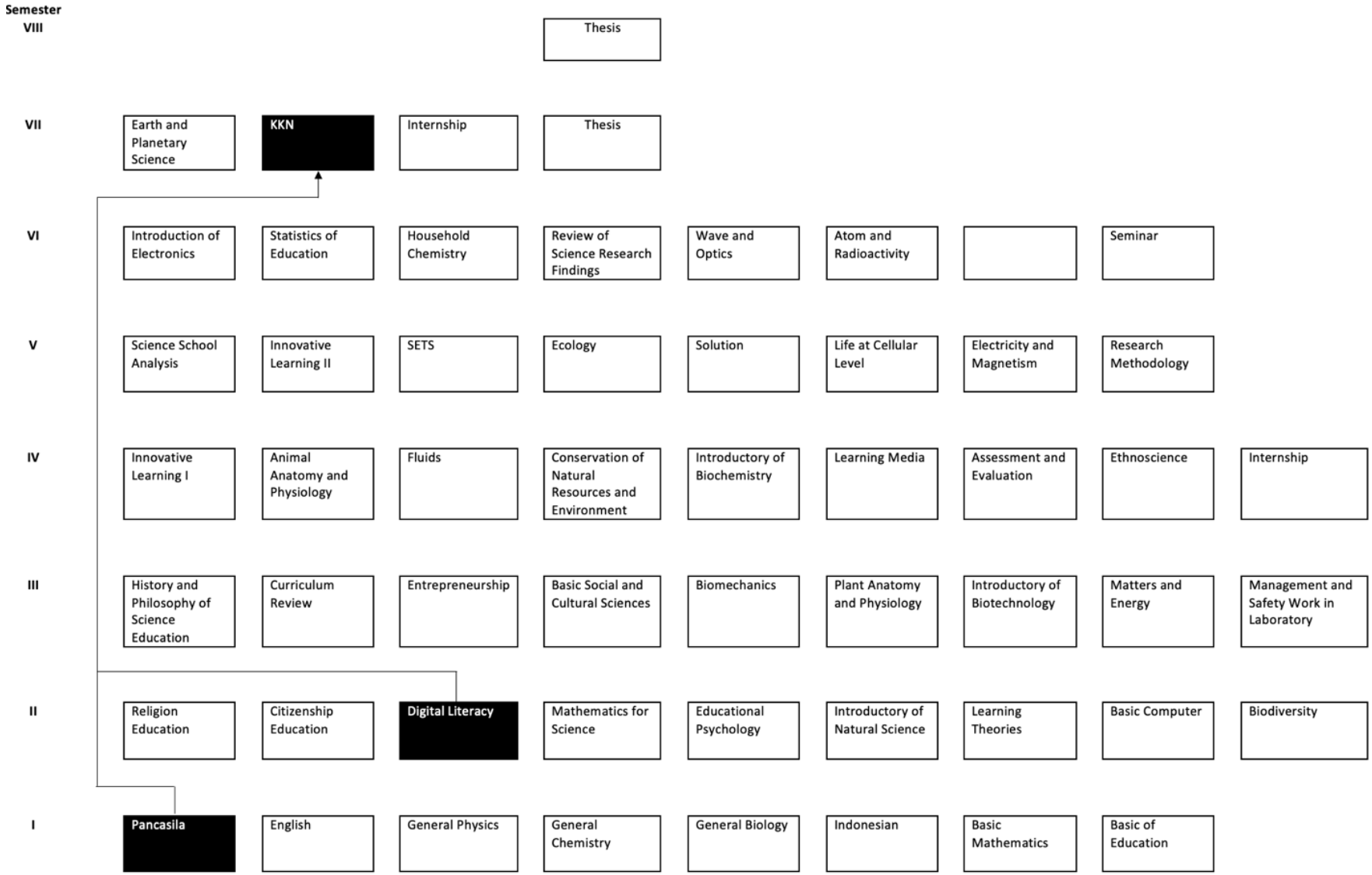
## PLO 7 ROADMAP



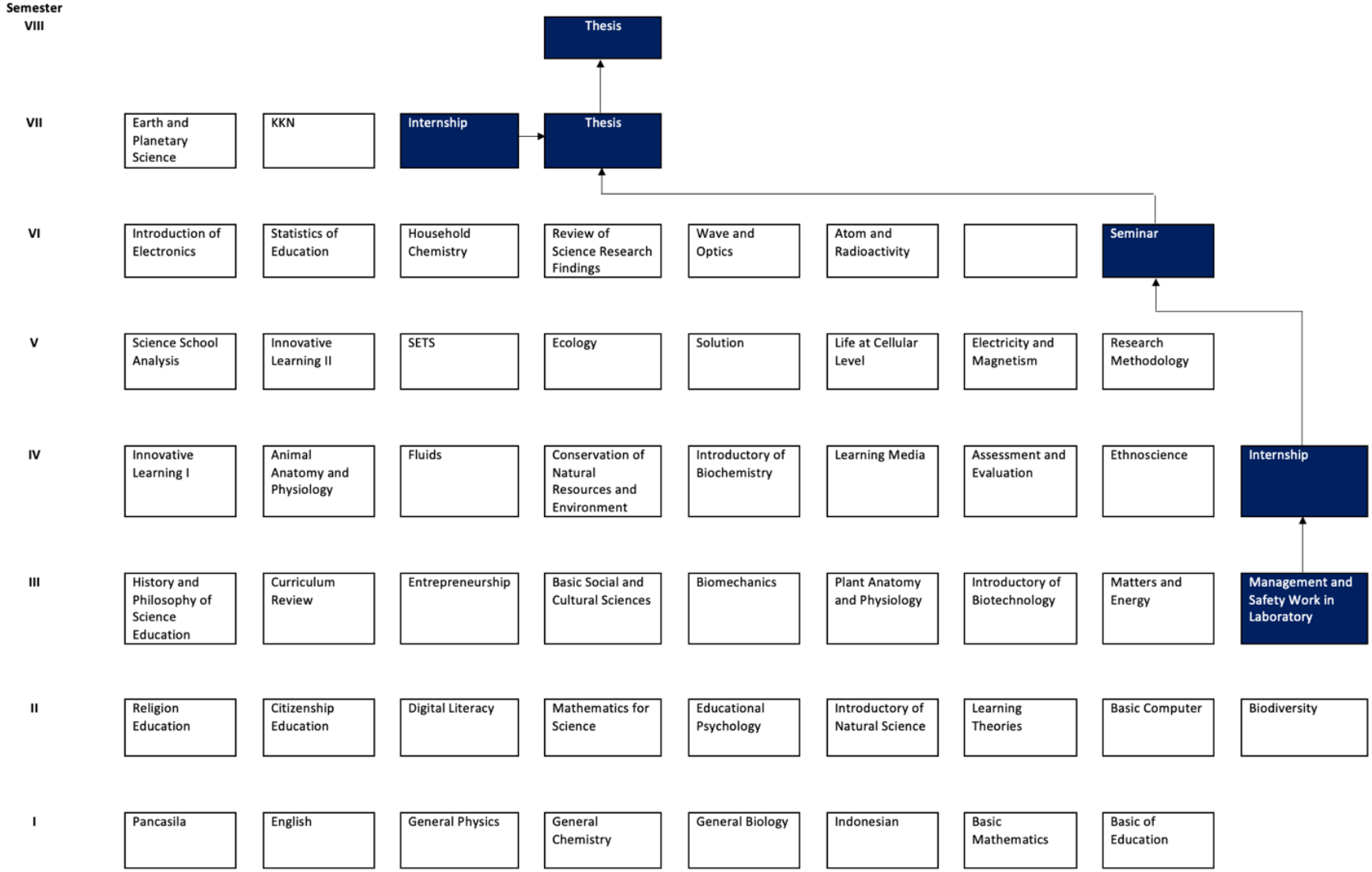
## PLO 8 ROADMAP



## PLO 9 ROADMAP



## PLO 10 ROADMAP



## PLO 11 ROADMAP

