

Summary of Curriculum

Undergraduate Program in Physics Education
Faculty of Mathematics and Natural Science
Universitas Negeri Surabaya
2020

OBJECTIVES OF THE DEGREE PROGRAM

1. Vision and Mission of Institution

Vision of Universitas Negeri Surabaya (Unesa):

Excellent in Education, Strong in Science

Mission of 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.

Mission of 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 FMNS

a) Produces graduates in mathematics and natural sciences and education having environmental insight, entrepreneurial spirit, and global competitiveness.
b) Yields research results in mathematics and natural sciences and education to strengthen the studies of MNS and MNS education.
c) Implements research results for community services to support community welfare.
d) Executes strong collaboration with stakeholders to improve the quality and image of FMIPA.

Realizes a governance system in FMNS that is autonomous, credible, fair, accountable, and transparent for quality assurance and quality improvement.

2. Program Education Objective (PEO)

As a consequence of the vision and mission of the institution (i.e. Unesa and FMNS) as well as the mandate of Rector Decree, i.e. SK No. 466/UN38/HK/DT/2016 to change the teaching paradigm into student-centered learning and outcome-centered learning, the Program Education Objectives (PEOs) of the Physics Education focus on producing graduates who are capable of becoming reliable professionals, leaders and agents of change in society with adequate capability to be responsive and adaptive to the challenges met.

Produce graduates who at the beginning of their careers become Physics educators, laboratory managers, employees of educational institutions, entrepreneurs, research assistants; have the ability to continue their studies to a higher level of education and have a superior character, environmental insight, and entrepreneurial spirit that able to compete at national and international level. In detail, the PEOs are as follows:

1. Produce graduates who are able to use pedagogical knowledge and skills to solve problems in work.
2. Produce graduates who have a strong commitment to developing knowledge, whether further study or working formally or informally.
3. Produce graduates who master scientific methods to analyze and develop innovations in learning physics, and produce scientific work and contribute in their fields.
4. Produce graduates who master the fields of physics and learning, are able to apply their knowledge and expertise in various fields of work and are able to develop themselves in their career environment.
5. Produce graduates who are able to communicate orally and or in writing effectively, creatively, innovatively and collaboratively, as well as working in teams.

The formulated PEOs have extensively considered the inputs from academic staff meeting of the department of Physics Education and the FMNS, alumni, professionals, Physics Society Indonesia (i.e. PSI). The PEOs also have significant relevancies with the Indonesian National Qualification Framework (KKNI).

1. Being able to apply their field of expertise and utilizing science and technology in their fields in problem solving and being able to adapt to the situation at hand.
2. Mastering theoretical concepts in a particular field of knowledge in general and the theoretical concepts of special sections in that field of knowledge in depth, as well as being able to formulate procedural problem solving.
3. Able to take appropriate decisions based on analysis of information and data, and be able to provide guidance in choosing alternative solutions independently and in groups.

4. Be responsible for the work itself and can be given responsibility for the achievement of the work of the organization.

3. Program Learning Outcomes (PLO)

Derived from the PEOs, the Physics Education has the following Program Learning Outcomes (PLOs) for its graduates set:

Table 1. PLO of undergraduate program of Physics Education

ASPECTS	PLO	CODE
KNOWLEDGE	1. Demonstrate their knowledge of classical physics and modern physics	**KNO-1**
	2. Formulate a physical system as a physical model by using mathematics	**KNO-2**
	3. Demonstrate pedagogical knowledge in planning, teaching, and evaluating of physics learning	**KNO-3**
	4. Demonstrate knowledge in relating to physics education research	**KNO-4**
SKILL	1. Plan, do, and evaluate of physics learning by using information and communication technology	**SKI-1**
	2. Design and conduct experiments in learning physics by applying the scientific method	**SKI-2**
	3. Improve their knowledge and be able to continue their study in a higher degree program	**SKI-3**
COMPETENCES	1. Communicate the ideas and research results in verbal as well as written effectively	**COM-1**
	2. Make a decision based on the data or information in order to fulfill and evaluate the tasks responsibility	**COM-2**
	3. Work as an individual as well as a team effectively, have an entrepreneur skills, and awareness of environmental issues	**COM-3**
ATTITUDE AND SOCIAL	1. Demonstrate good scientific manners, critical thinking, and innovation skills in educational, research, and professional fields	**SOC-1**
	2. Demonstrate the appreciation of religious and cultural values in conducting their tasks as a professional.	**SOC-2**

4. PLO vs Indonesian National Qualification Framework (INQF) (Level-6)

Table 2. The relation between PLO and INQF

Objective	Being able to apply their field of expertise and utilizing science and technology in their fields in problem solving and being able to adapt to the situation at hand	Mastering theoretical concepts in a particular field of knowledge in general and the theoretical concepts of special sections in that field of knowledge in depth, as well as being able to formulate procedural problem solving	Able to take appropriate decisions based on analysis of information and data, and be able to provide guidance in choosing alternative solutions independently and in groups.	Be responsible for the work itself and can be given responsibility for the achievement of the work of the organization.
PEO-1	S	S	S	M
PEO-2	S	S	S	S
PEO-3	S	S	S	M
PEO-4	S	S	S	S
PEO-5	S	S	S	S

Note: S-Strong; M-Moderate

5. The correlation between the PLOs and the PEOs.

Table 3. Matrix of the Correlation between Objectives of the Undergraduate Program in Physics Education and the Program Learning Outcomes

	Objective 1 Produce graduates who are able to use pedagogical knowledge and skills to solve problems in work.	**Objective 2 Produce graduates who have a strong commitment to developing knowledge, whether further study or working formally or informally.**	**Objective 3 Produce graduates who master scientific methods to analyze and develop innovations in learning physics, and produce scientific work and contribute in their fields.**	**Objective 4 Produce graduates who master the fields of physics and learning, are able to apply their knowledge and expertise in various fields of work and are able to develop themselves in their career environment.**	**Objective 5 Produce graduates who are able to communicate orally and or in writing effectively, creatively, innovatively and collaboratively, as well as working in teams.**
KNO 1	√	√	√	√	√
KNO 2	√	√	x	√	x
KNO 3	√	√	x	√	x
KNO 4	√	√	√	√	√
SKI 1	√	x	√	√	√
SKI 2	√	x	√	x	x
SKI 3	√	√	√	√	√
COM 1	√	x	√	x	√
COM 2	√	x	√	√	√
COM 3	√	x	√	√	√
SOC 1	√	x	√	√	√
SOC 2	√	√	√	√	√

** √-Yes, X-No*

6. Mapping of Subject-Specific Criteria (ASIIN) with Program Learning Outcomes (PLO)

Table 4. The mapping of SSC ASIIN and PLO

ASIIN Subject Specific Criteria for Physics (ASIIN-SSC)		Program Learning Outcome (PLO)											
		KNO1	KNO2	KNO3	KNO4	SKI1	SKI2	SKI3	COM1	COM2	COM3	SOC1	SOC2
1	They have sound knowledge of classical physics (mechanics, electrodynamics, thermodynamics, vibrations, waves and optics) and are familiar with the fundamentals of quantum, atomic and molecular, nuclear, elementary particle and solid-state physics.	√											
2	They are familiar with important mathematical methods used in physics and can use these to solve physics problems.		√										
3	They have an extensive understanding of the fundamental principles of physics, their inherent relation and mathematical formulation and, based on this, have acquired methods suitable for theoretical analysis, modeling and simulation of relevant processes.	√	√	√									
4	They have applied their knowledge to physics problems in an exemplary manner and studied some areas in greater depth, thereby acquiring a first basis for problem solving competence.			√	√								
5	They have a basic capacity to comprehend physics problems. This will in general however not yet facilitate a deeper understanding of current research areas.			√	√	√							
6	They are therefore in a position to independently classify physics-based and to some extent also interdisciplinary problems that require a target-oriented and logic-based approach, and to analyze and/or solve them by using natural scientific and mathematical methods.					√	√					√	

ASIIN Subject Specific Creteria for Physics (ASIIN-SSC)		Program Learning Outcome (PLO)											
		KNO1	KNO2	KNO3	KNO4	SKI1	SKI2	SKI3	COM1	COM2	COM3	SOC1	SOC2
7	They are familiar with basic principles of experimentation, are able to use modern physics measurement methods, and are in a position to assess the significance of results correctly.						√						
8	They have generally also acquired an overview knowledge in selected other natural science subjects or technical disciplines.											√	√
9	They are able to apply their knowledge to different fields and act responsibly in their professional activity. They are moreover able to recognize new trends in their subject area and integrate the relevant methodology – possibly after appropriate qualification – into their further work.									√	√	√	
10	They are able to continuously and self-reliantly extend and deepen the knowledge acquired in the Bachelor's degree program. They are familiar with suitable learning strategies (lifelong learning) for this; they are in particular capable of a consecutive Master's degree program in principle.					√	√	√					
11	They have gained initial experience with regard to generic qualifications (e.g. time man-agreement, study and work techniques, willingness to cooperate, capacity for teamwork, ability to communicate and communication techniques, rules of good scientific practice) in their degree program, and are able to develop these skills further.							√	√		√		
12	They are familiar with the basic elements of the relevant specialized English.							√	√				
13	They are able to solve a simple scientific problem and to present their results orally (lecture) and in writing (demonstrated in a Bachelor's thesis).								√	√			

7. PROGRAM STRUCTURE

As mentioned, besides based on the inputs from stakeholders, the improvements of the physics education's curriculum structure were also a result of evaluation on current conditions and future needs of the profession in the field of physics, taking into account both national and global challenges being faced as summarized in Figure 1.

By accommodating those challenges, the structure as well as the course syllabus have been revised and applied within the period of 2015 - 2018. Continuous evaluation of the implementation is conducted annually.

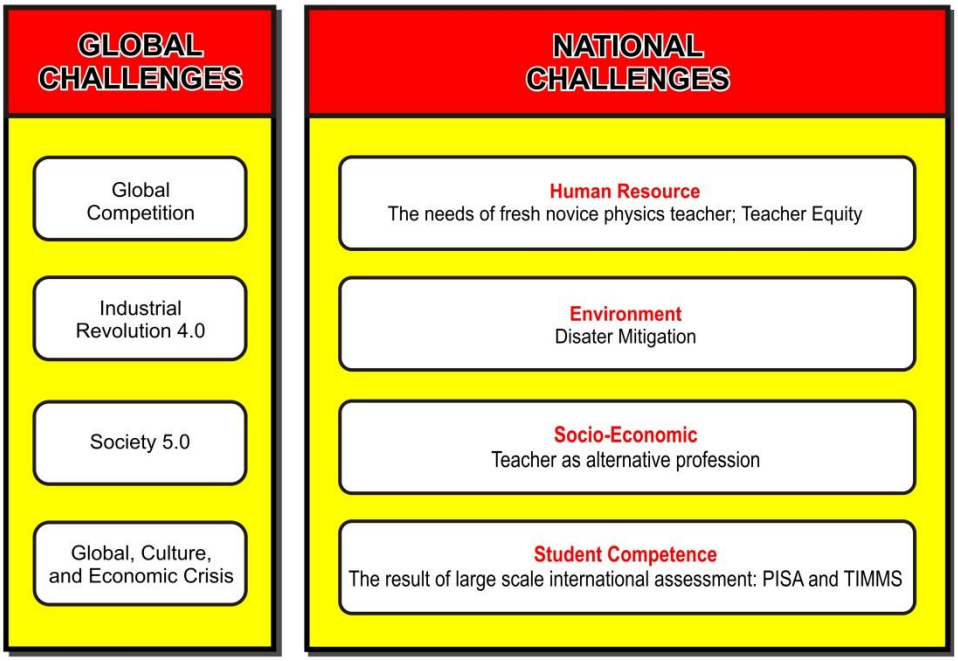


Figure 1. Recognized Challenges in the Field of Physics Education

The curriculum of physics education is delivered in 4 phases/years through 3 main structures: basic knowledge, expertise knowledge and synthesis, as illustrated in Figure 2. In this structure, the learning process to gain competence is modeled as a house. Basic knowledge is the foundation of the program, expertise knowledge as the pillars, and the synthesis of knowledge as the roof which cover all urban and regional planning knowledge.

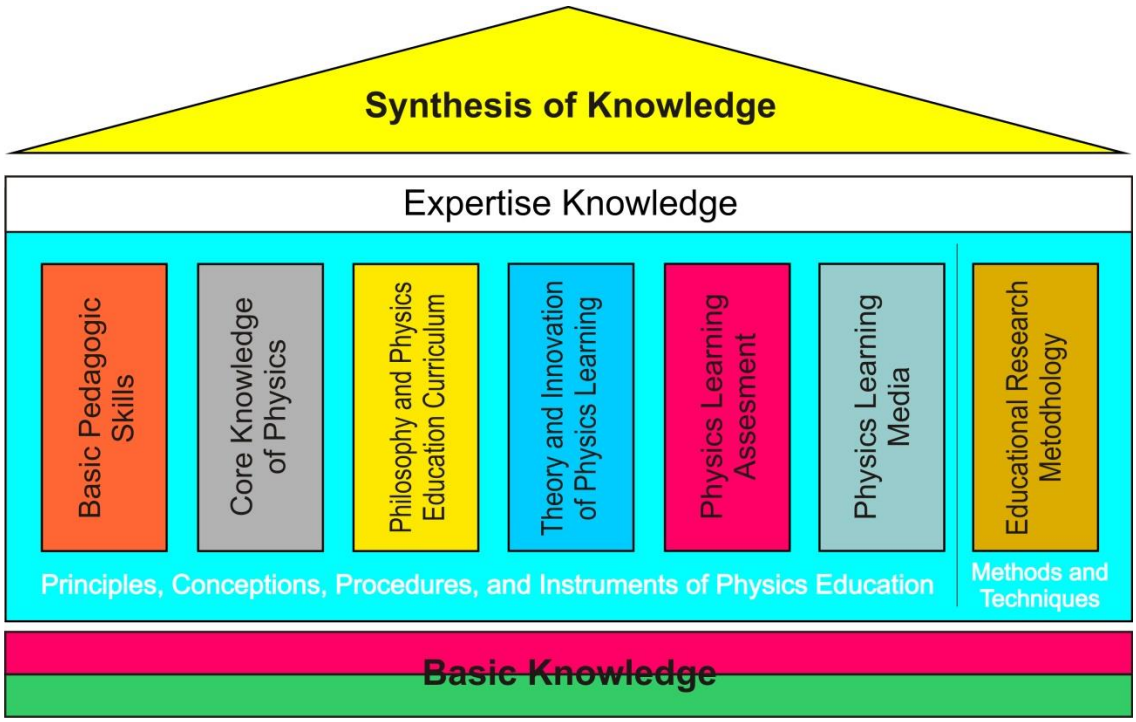


Figure 2. Physics Education's Curriculum Structure

The minimum workload of Undergraduate Program at Unesa is 144 credit units (CU) which correspond to 6,048 hours[1] or 201.6 ECTS[2], 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. The mapping of curriculum content into PLO

No	Code	Course Name	CU	PLO											
				KNO 1	KNO 2	KNO 3	KNO 4	SKI 1	SKI 2	SKI 3	COM 1	COM 2	COM 3	SOC 1	SOC 2
1	0001212008	Pancasila Education	2												√
2	0001212009	Indonesian	2												√
3	0002213001	Basic Education	3			√	√								
4	8420303065	Basic Physics I	3	√	√										
5	8420303029	General Biology	3										√		
6	8420303106	General Chemistry	3										√		
7	8420303117	Basic Mathematics	3		√										
8	8420302188	Physics Measurement System	2						√						
9	8420301170	Basic Physics Practicum I	1						√						
10	842030223x	Religious Education	2												√
11	1000002033	Civic Education	2												√
12	8420303013	English	3								√				
13	8420302232	Digital Literacy	2					√							
14	1000002039	Educational Psychology	2				√								
15	8420303066	Basic Physics II	3	√	√										
16	8420302107	Natural Resource Conservation	2										√		
17	8420303235	Mathematical Physics I	3		√										
18	8420301171	Basic Physics Practicum II	1						√						
19	8420302236	Learning Theories	2			√									
20	8420302233	Physical Education and Fitness	2										√		
21	8420304130	Mechanics	4	√											
22	8420303218	Thermodynamics	3	√											
23	8420302237	Basic Electronics I	2	√											
24	8420303238	Mathematical Physics II	3	√	√										
25	8420301239	Electronics Practicum I	1						√						
26	8420302240	Learning Evaluation	2			√									
27	0002212006	Basic Social and Cultural Sciences	2												√
28	8420303115	Electromagnetism	3	√											
29	8420303076	Modern Physics	3	√											
30	8420302241	Basic Electronics II	2	√											

No	Code	Course Name	CU	PLO											
				KNO 1	KNO 2	KNO 3	KNO 4	SKI 1	SKI 2	SKI 3	COM 1	COM 2	COM 3	SOC 1	SOC 2
31	8420303081	Waves	3	√											
32	8420302043	Physics Experiment I	2						√						
33	8420301242	Electronics Practicum II	1						√						
34	8420303196	Statistics	3		√										
35	8420302243	Educational Philosophy	2			√									
36	8420302244	Innovative Learning Planning	2			√									
37	8420302224	Entrepreneurship	2										√		
38	8420302247	Statistical Physics	2	√											
39	8420303069	Quantum Physics	3	√											
40	8420303077	Physics for School	3			√									
41	8420302044	Physics Experiment II	2						√						
42	8420302250	School Curriculum	2			√									
43	8420302129	Learning Media	2					√							
44	8420304249	Research Methodology	4			√	√								
45	8420302144	Optics	2	√											
46	8420303080	Solid State Physics	3	√											
47	8420302108	Physics Laboratory	2						√						
48	8420302099	Earth and Space Science	2	√											
49	8420302184	Seminar	2			√	√	√			√	√		√	
50	8420302255	Physics Experiment III	2						√						
51	8420302230	Microteaching	2			√	√	√	√		√	√	√	√	
52	8420301256	Introduction to School I	1			√	√	√	√		√	√	√	√	√
53	8420303068	Nuclear Physics	3	√											
54	8420301257	Introduction to School II	3			√	√	√	√		√	√	√	√	√
55	8420303226	Community Service Program	3			√	√	√	√		√	√	√	√	√
56	8420306189	Thesis	6	√	√	√	√	√	√	√	√	√	√	√	√
57	8420302262	Astronomy	2	√						√					
58	8420302266	Robotics Physics	2	√					√	√					
59	8420302063	Earth Science	2	√						√					
60	8420302272	Energy material	2	√						√					
61	8420302261	Disaster Mitigation	2	√						√			√		
62	8420302132	Mechanical of technique	2	√						√					

No	Code	Course Name	CU	PLO											
				KNO 1	KNO 2	KNO 3	KNO 4	SKI 1	SKI 2	SKI 3	COM 1	COM 2	COM 3	SOC 1	SOC 2
63	8420302178	Electrical Circuits	2	√					√	√					
64	8420302073	Advanced Mathematical Physics	2		√					√					
65	8420302183	History of Physics	2	√						√					
66	8420302268	Physics Argumentation	2			√				√					
67	8420302263	Olympic Physics	2	√						√					
68	8420302271	Development of Physics Curriculum	2			√	√			√					
69	8420302254	Physics Local Wisdom	2			√				√					√
70	8420302258	Advanced Innovative Learning	2			√	√	√		√					
71	8420302265	STEAM Learning	2			√	√	√		√					
72	8420302253	Physics e-learning	2			√		√		√					
73	8420302098	Integrated Science	2			√	√			√					
74	8420302267	School Laboratory Management	2			√			√	√					
75	8420302252	Audio-visual Physics	2			√		√		√					
76	8420302246	Physics of Photography	2			√		√		√					
77	8420302143	Multimedia	2			√		√		√					
78	8420302269	Physics Edutainment	2			√		√		√					
79	8420302259	Physics Communication and Media Analysis	2			√		√		√					
80	8420302264	Measurement and Instruments of Physics Education	2			√			√	√					
81	8420302251	Study of UN, TIMSS, and PISA	2			√				√					
82	8420302245	Physics Literacy	2			√				√					
83	8420302260	Item Response Theory	2			√		√		√					
84	8420302270	Computer Based Assessment	2			√		√		√					

The detailed curriculum structure each semester is shown in tables below.

Table 6. Physics Education's Curriculum Structure

1st Semester				2nd Semester			
No	Code	Course Title	CU	No	Code	Course Title	CU
1	0001212008	Pancasila Education (*Pendidikan Pancasila*)	2	1	842030223x	Religious Education (*Pendidikan Agama*)	2
2	0001212009	Indonesian (*Bahasa Indonesia*)	2	2	1000002033	Civic Education (*Pendidikan Kewarganegaraan*)	2
3	0002213001	Basic Education (*Dasar-dasar Pendidikan*)	3	3	8420303013	English (*Bahasa Inggris*)	3
4	8420303065	Basic Physics I (*Fisika Dasar I*)	3	4	8420302232	Digital Literacy (*Literasi Digital*)	2
5	8420303029	General Biology (*Biologi Umum*)	3	5	1000002039	Educational Psychology (*Psikologi Pendidikan*)	2
6	8420303106	General Chemistry (*Kimia Umum*)	3	6	8420303066	Basic Physics II (*Fisika Dasar II*)	3
7	8420303117	Basic Mathematics (*Matematika Dasar*)	3	7	8420302107	Natural Resource Conservation (*Konservasi Sumber Daya Alam*)	2
8	8420302188	Physics Measurement System (*Sistem Pengukuran Fisika*)	2	8	8420303235	Mathematical Physics I (*Fisika Matematik I*)	3
9	8420301170	Basic Physics Practicum I (*Praktikum Fisika Dasar I*)	1	9	8420301171	Basic Physics Practicum II (*Praktikum Fisika Dasar II*)	1
				10	8420302236	Learning Theories (*Teori Belajar*)	2
Total			**22**	**Total**			**22**

3th Semester				4th Semester			
NO	Code	Course Title	CU	NO	Code	Course Title	CU
1	8420302233	Physical Education and Fitness (*Pend. Jasmani dan Kebugaran*)	2	1	8420303115	Electromagnetism (*Listrik Magnet*)	3
2	8420304130	Mechanics (*Mekanika*)	4	2	8420303076	Modern Physics (*Fisika Modern*)	3
3	8420303218	Thermodynamics (*Termodinamika*)	3	3	8420302241	Basic Electronics II (*Elektronika Dasar II*)	2
4	8420302237	Basic Electronics I (*Elektronika Dasar I*)	2	4	8420303081	Waves (*Gelombang*)	3
5	8420303238	Mathematical Physics II (*Fisika Matematik II*)	3	5	8420302043	Physics Experiment I (*Eksperimen Fisika I*)	2
6	8420301239	Electronics Practicum I (*Praktikum Eldas I*)	1	6	8420301242	Electronics Practicum II (*Praktikum Eldas II*)	1
7	8420302240	Learning Evaluation (*Evaluasi Belajar dan Pembelajaran*)	2	7	8420303196	Statistics (*Statistika*)	3
8	0002212006	Basic Social and Cultural Sciences (*ISBD*)	2	8	8420302243	Educational Philosophy (*Filsafat Pendidikan*)	2
				9	8420302244	Innovative Learning Planning (*Perencanaan Pembelajaran Inovatif*)	2
Total			**19**	**Total**			**21**

5th Semester				6th Semester			
NO	Code	Course Title	CU	NO	Code	Course Title	CU
1	8420302224	Entrepreneurship (*Kewirausahaan*)	2	1	8420302144	Optics (*Optik*)	2
2	8420302247	Statistical Physics (*Fisika Statistik*)	2	2	8420303080	Solid State Physics (*Fisika Zat Padat*)	3
3	8420303069	Quantum Physics (*Fisika Kuantum*)	3	3	8420302108	Physics Laboratory (*Laboratorium Fisika*)	2
4	8420303077	Physics for School	3	4	8420302099	Earth and Space Science	2

		(*Fisika Sekolah*)				(*IPBA*)	
5	8420302044	Physics Experiment II (Eksperimen Fisika II)	2	5	8420302184	Seminar	2
6	8420302250	School Curriculum (*Kurikulum Sekolah*)	2	6	8420302255	Physics Experiment III (*Eksperimen Fisika III*)	2
7	8420302129	Learning Media (*Media Pembelajaran*)	2	7	8420302230	Microteaching (*Pembelajaran Mikro*)	2
8	8420304249	Research Methodology (*Metodologi Penelitian*)	4	8	8420301256	Introduction to School I (*Pengenalan Lapangan Persekolahan I*)	1
Total			**20**	**Total**			**16**
7th Semester				**8th Semester**			
NO	**Code**	**Course Title**	**CU**		**Code**	**Course Title**	**CU**
1	8420303068	Nuclear Physics (*Fisika Inti*)	3	1	8420306189	Thesis (*Skripsi*)	6
2	8420301257	Introduction to School II (*Pengenalan Lapangan Persekolahan II*)	3				
3	8420303226	Community Service Program (*Kuliah Kerja Nyata*)	3				
Total			9	**Total**			6

Table 7. Elective Course in Physics Education

No	CODE	COURSE TITLE	CU	No	CODE	COURSE TITLE	CU
1	8420302262	Astronomy (Astronomi)	2	15	8420302265	STEAM Learning (Pembelajaran STEAM)	2
2	8420302266	Robotics Physics (Fisika Robotika)	2	16	8420302253	Physics e-learning (E-Learning Fisika)	2
3	8420302063	Earth Science (Fisika Bumi)	2	17	8420302098	Integrated Science (IPA Terpadu)	2
4	8420302272	Energy material (Material Energi)	2	18	8420302267	School Laboratory Management (Manajemen Laboratorium Sekolah)	2
5	8420302261	Disaster Mitigation (Mitigasi Bencana)	2	19	8420302252	Audiovisual Physics (Fisika Audiovisual)	2
6	8420302132	Mechanical of Technique (Mekanika Teknik)	2	20	8420302246	Physics of Photography (Fisika Fotografi)	2
7	8420302178	Electrical Circuits (Rangkaian Listrik)	2	21	8420302143	Multimedia	2
8	8420302073	Advanced Mathematical Physics (Fisika Matematika Lanjut)	2	22	8420302269	Physics Edutainment	2
9	8420302183	History of Physics (Sejarah Fisika)	2	23	8420302259	Physics Communication and Media Analysis (Komunikasi Fisika & Analisis Media)	2
10	8420302268	Physics Argumentation (Argumentasi Fisika)	2	24	8420302264	Measurement and Instruments of Physics Education (Pengukuran & Instrumen Pend Fisika)	2
11	8420302263	Olympic Physics (Fisika Olimpiade)	2	25	8420302251	Study of UN, TIMSS, and PISA (Kajian UN, TIMSS, dan PISA)	2
12	8420302271	Development of Physics Curriculum (Pengembangan Kurikulum Fisika)	2	26	8420302245	Physics Literacy (Literasi Fisika)	2
13	8420302254	Physics Local Wisdom (Kearifan Lokal Fisika)	2	27	8420302260	Item Response Theory (Teori Respon Butir)	2
14	8420302258	Advanced Innovative Learning (Pembelajaran Inovatif Lanjut)	2	28	8420302270	Computer Based Assessment (Penilaian Berbasis Komputer)	2
			28				**28**

Obligatory course = 135 CU
Selective course = 56 CU (minimum 9 CU)
Total = 144 CU

The relationship between one course and other courses within the framework of physics education curriculum structure is shown in Figure 3. The road-map also demonstrates that the curriculum structure consists of multi-discipline courses designed in 6 semesters in order to achieve the comprehensiveness in physics education. The roadmap also describes in different colored boxes corresponding to the physics education curriculum structure in Figure 2.

Roadmap of KNO-1

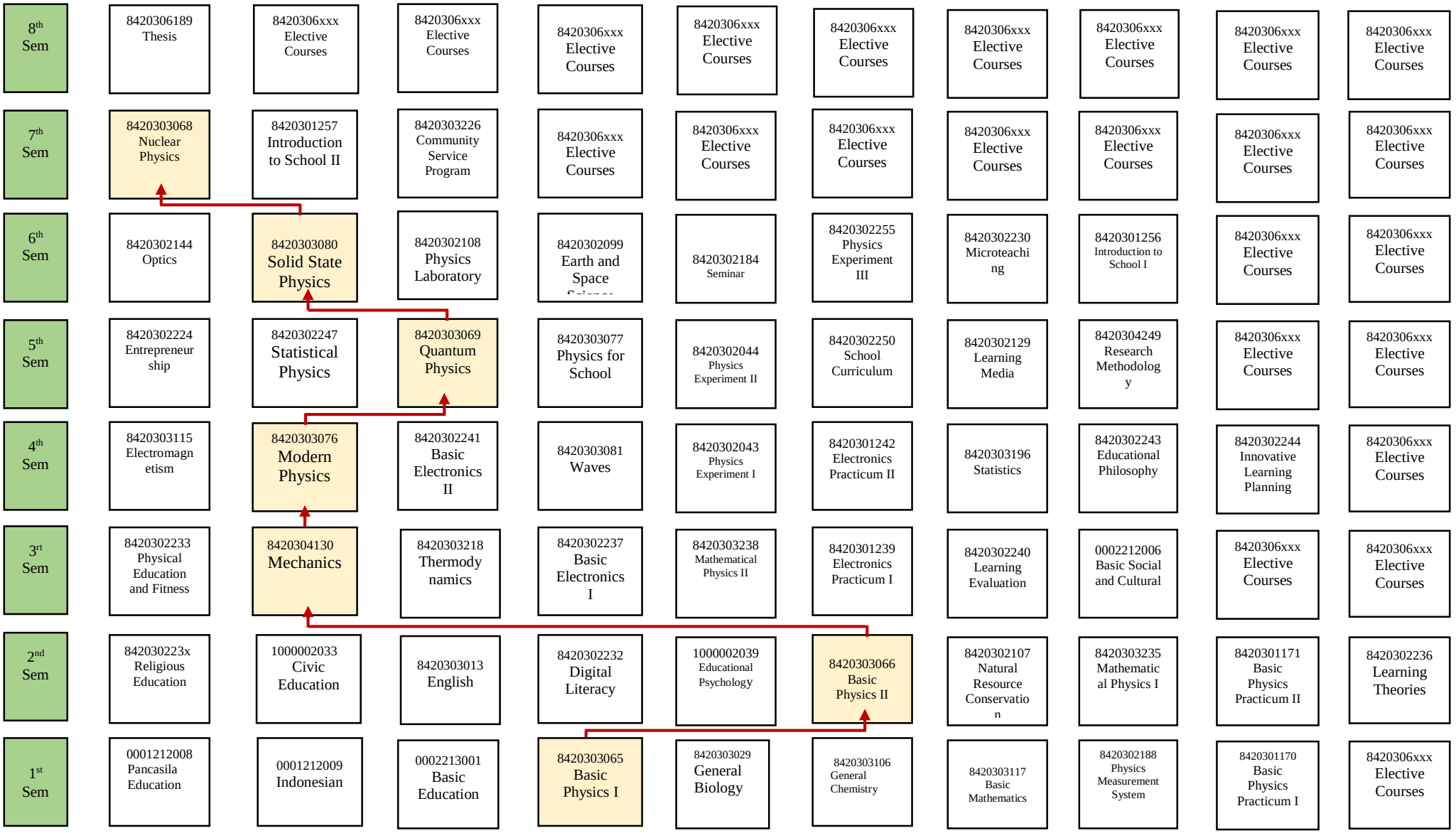


Figure 3. Course roadmap to achieve learning outcomes KNO-1

Roadmap of KNO-2

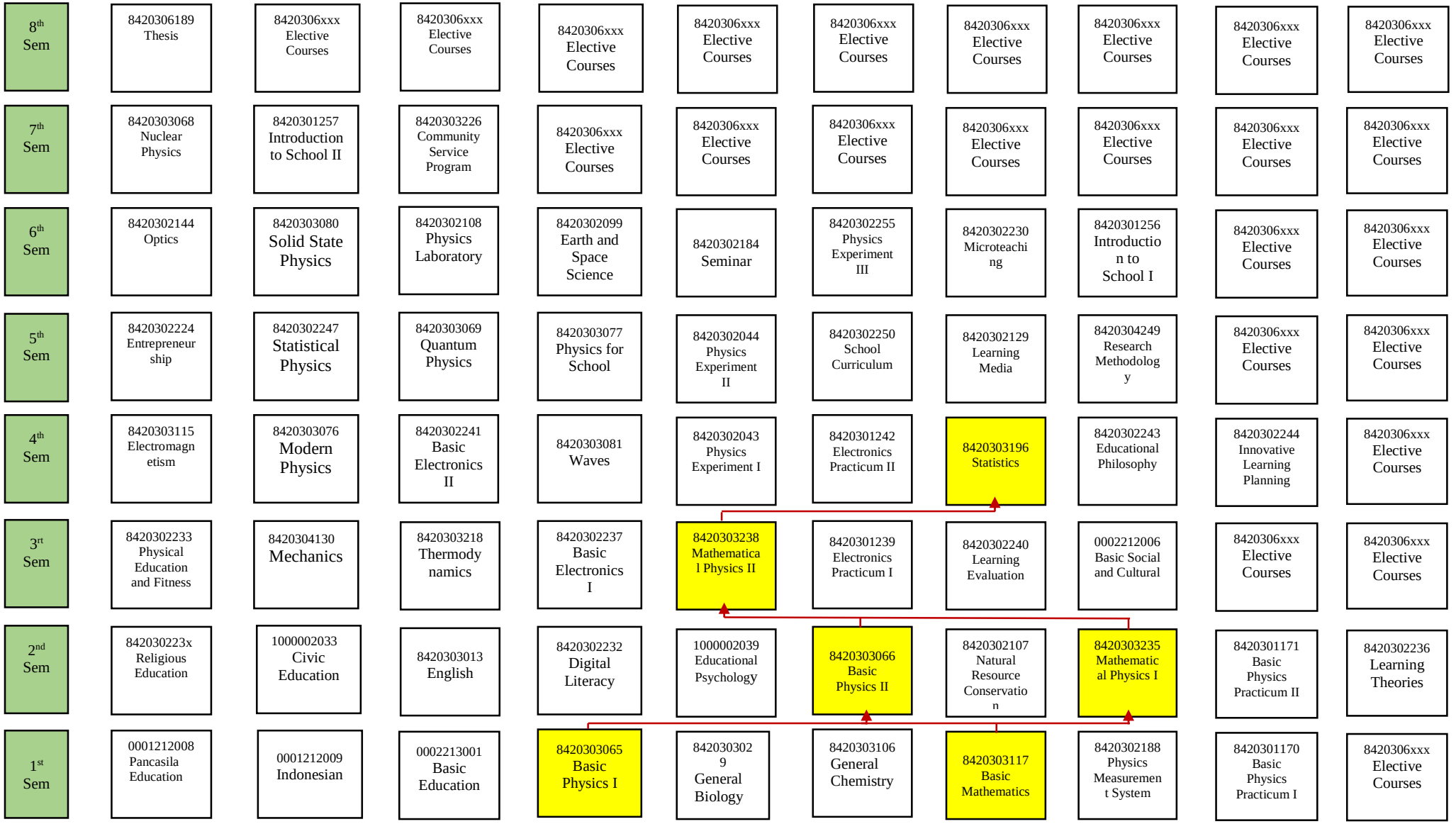


Figure 4. Course roadmap to achieve learning outcomes KNO-2

Roadmap of KNO-3

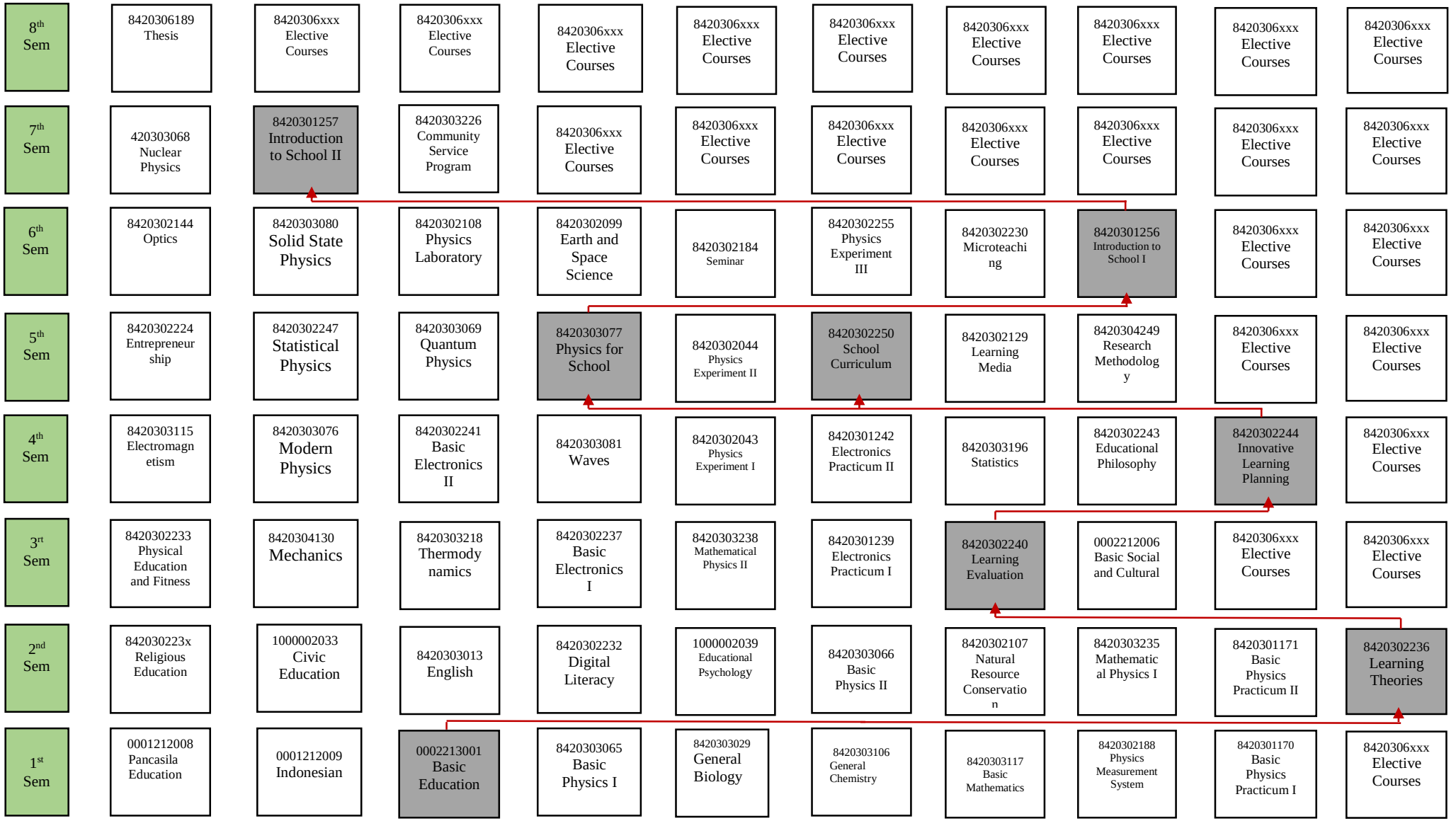


Figure 5. Course roadmap to achieve learning outcomes KNO-3

Roadmap of KNO-4

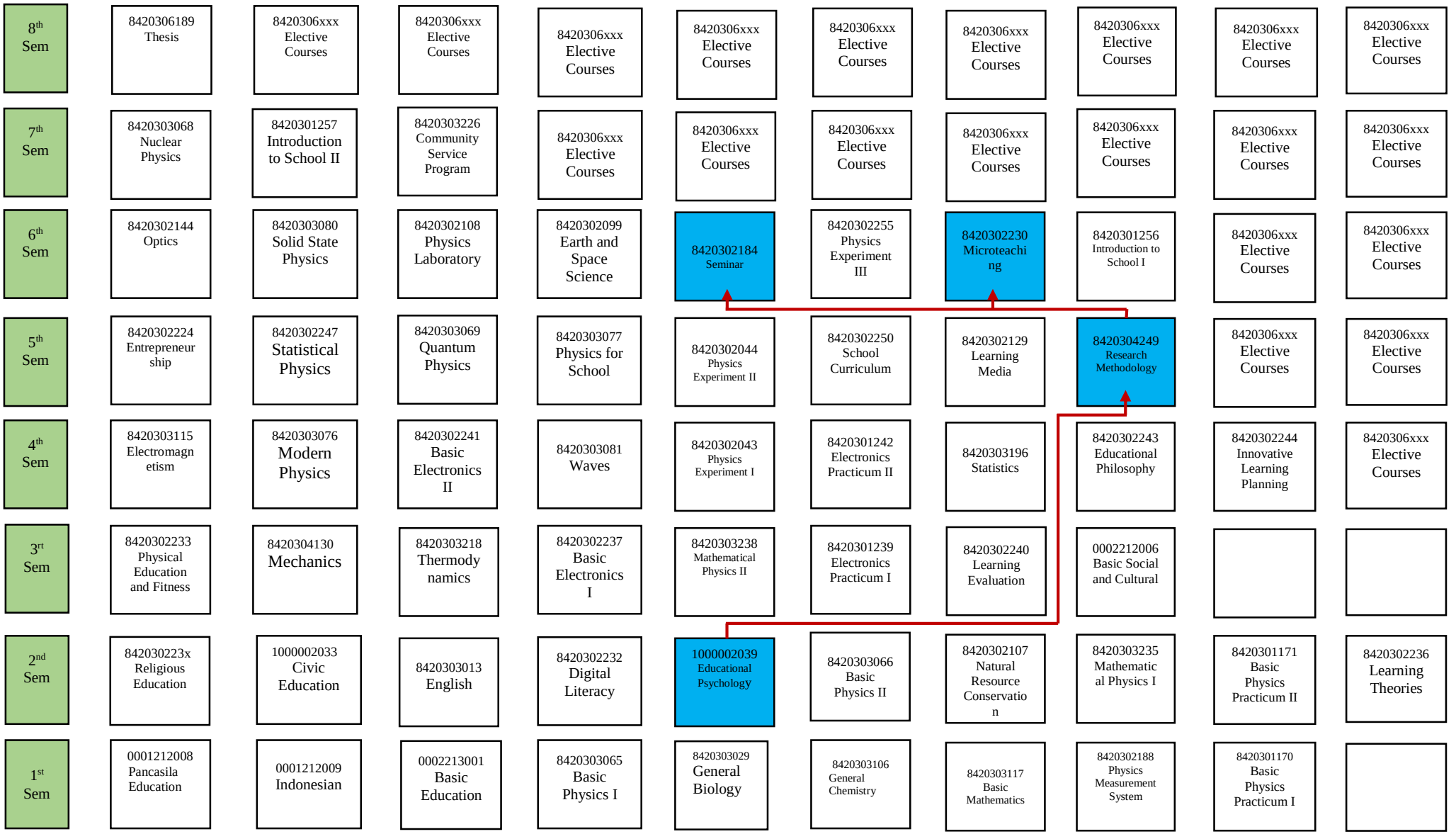


Figure 5. Course roadmap to achieve learning outcomes KNO-3

Roadmap of SKI-1

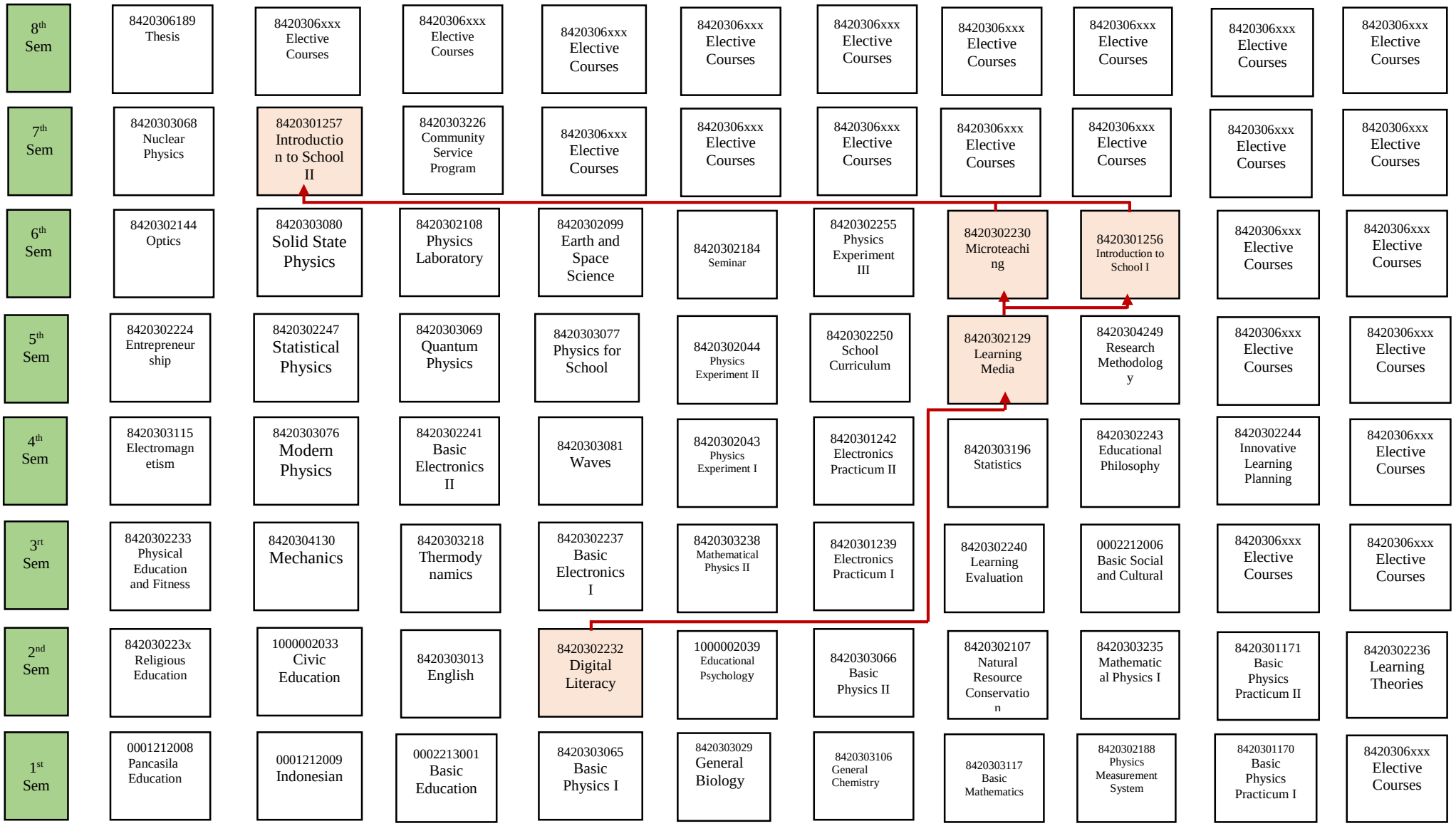


Figure 7. Course roadmap to achieve learning outcomes SKI-1

Roadmap of SKI-2

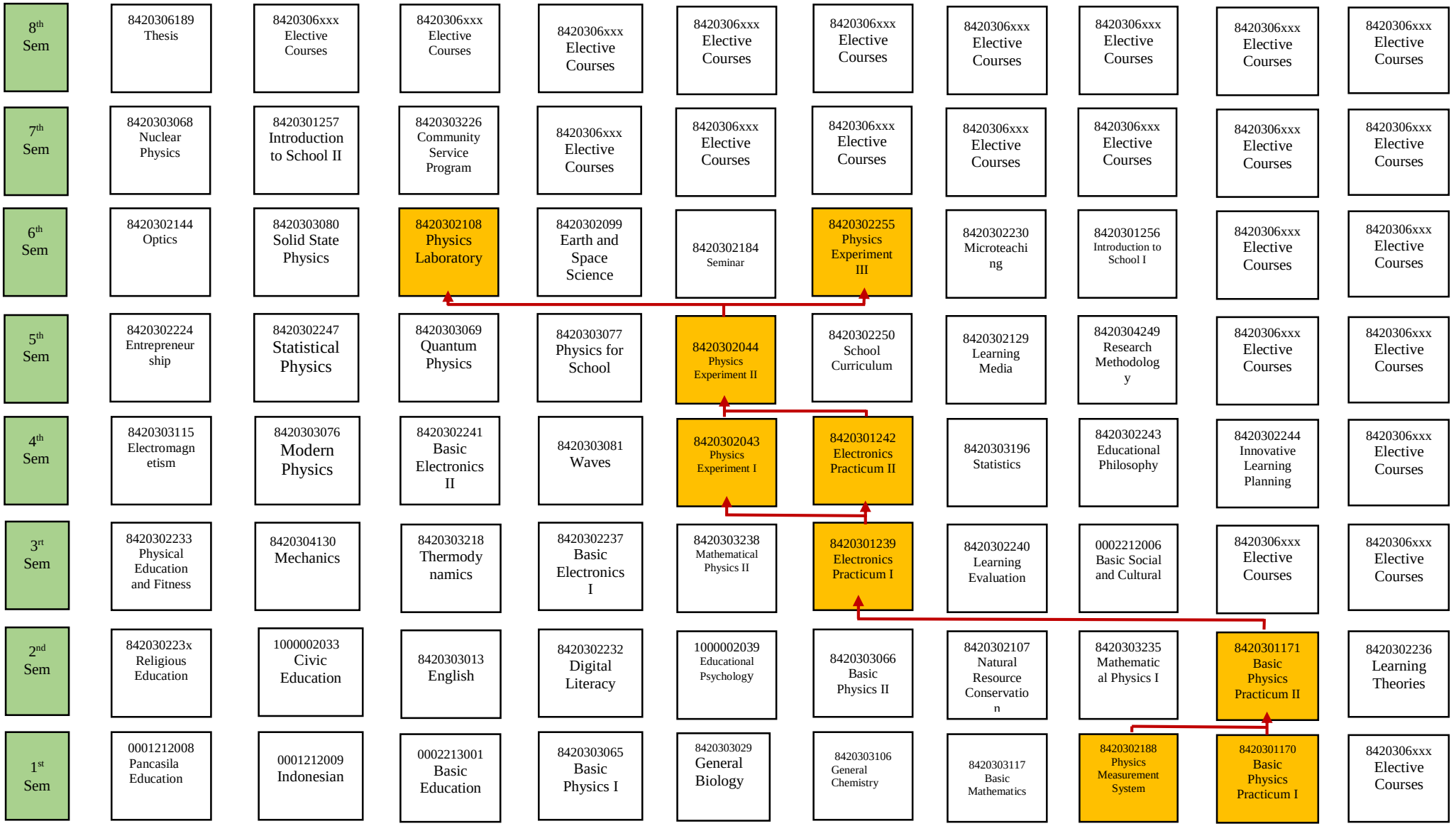


Figure 7. Course roadmap to achieve learning outcomes SKI-2

Roadmap of SKI-3

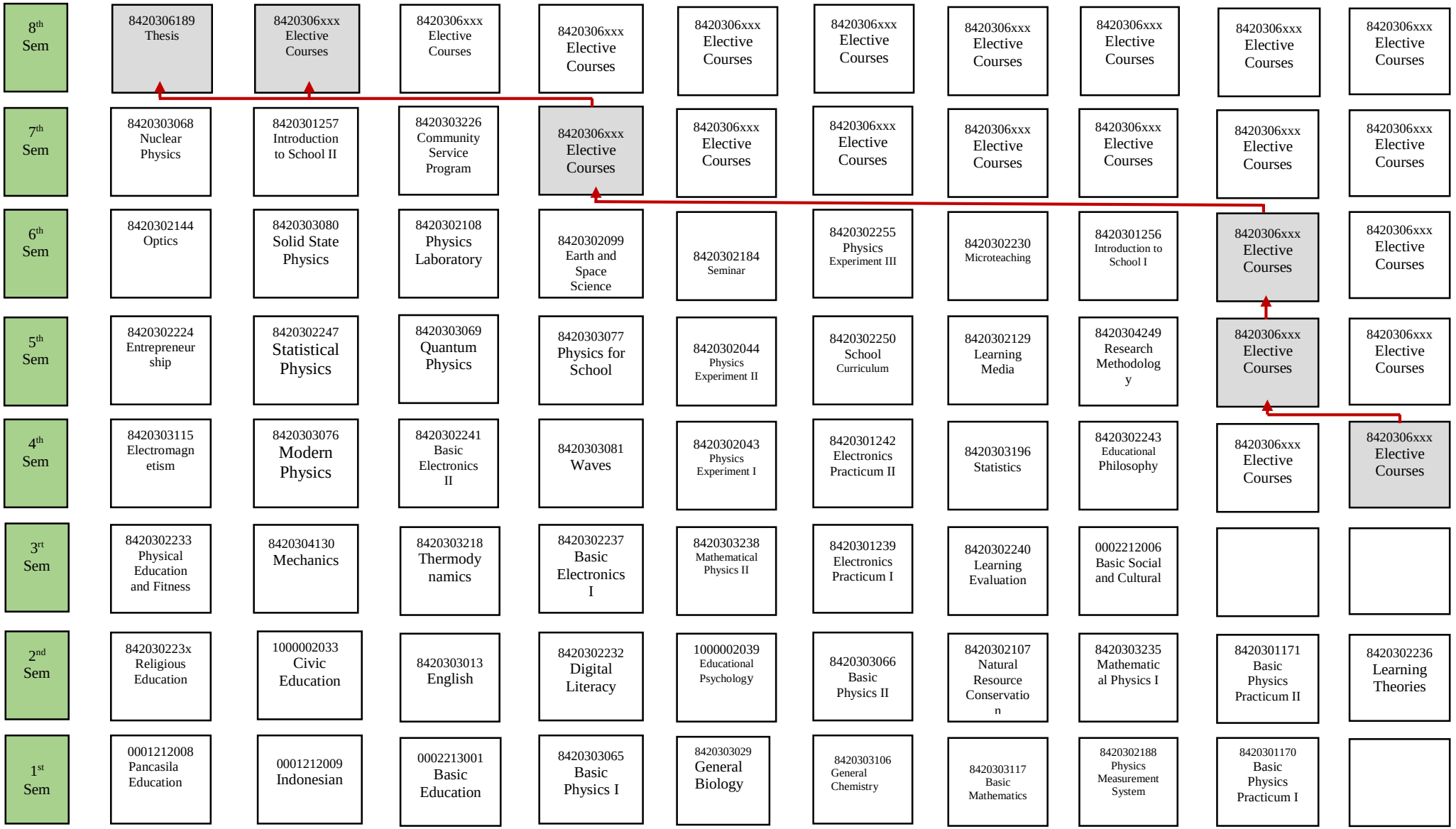


Figure 8. Course roadmap to achieve learning outcomes SKI-3

Roadmap of COM-1

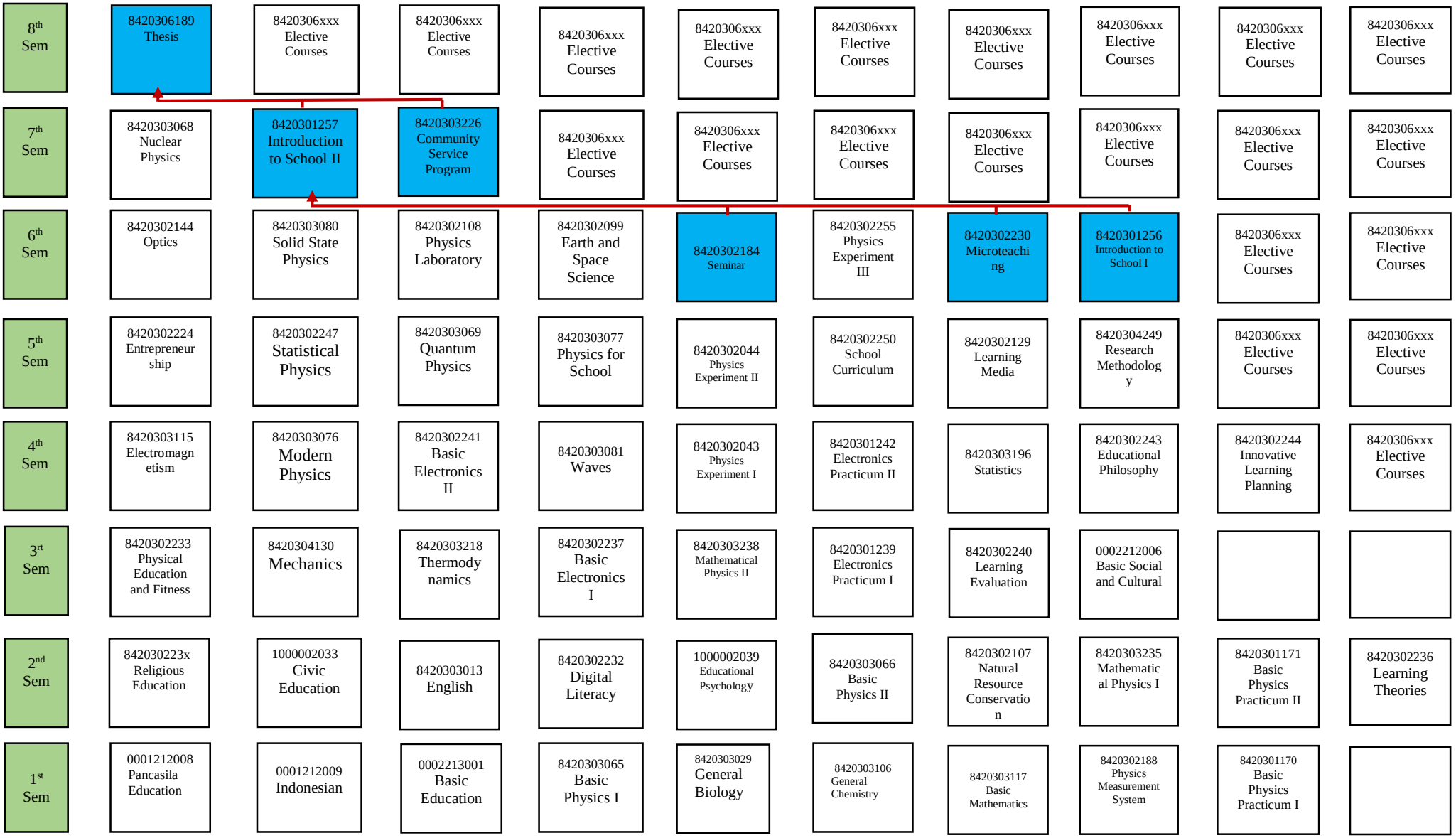


Figure 9. Course roadmap to achieve learning outcomes COM-1

Roadmap of COM-2

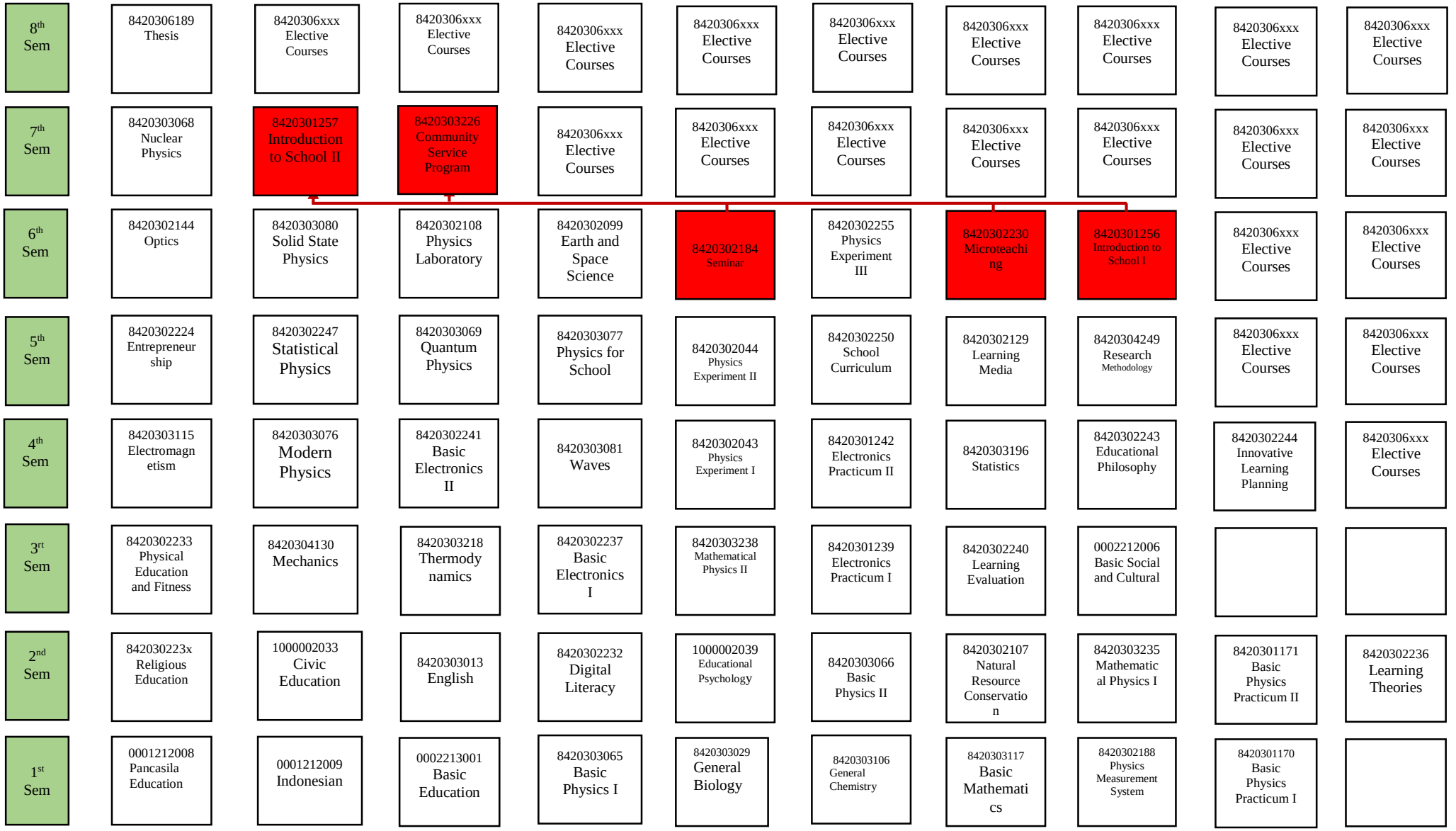


Figure 10. Course roadmap to achieve learning outcomes COM-2

Roadmap of COM-3

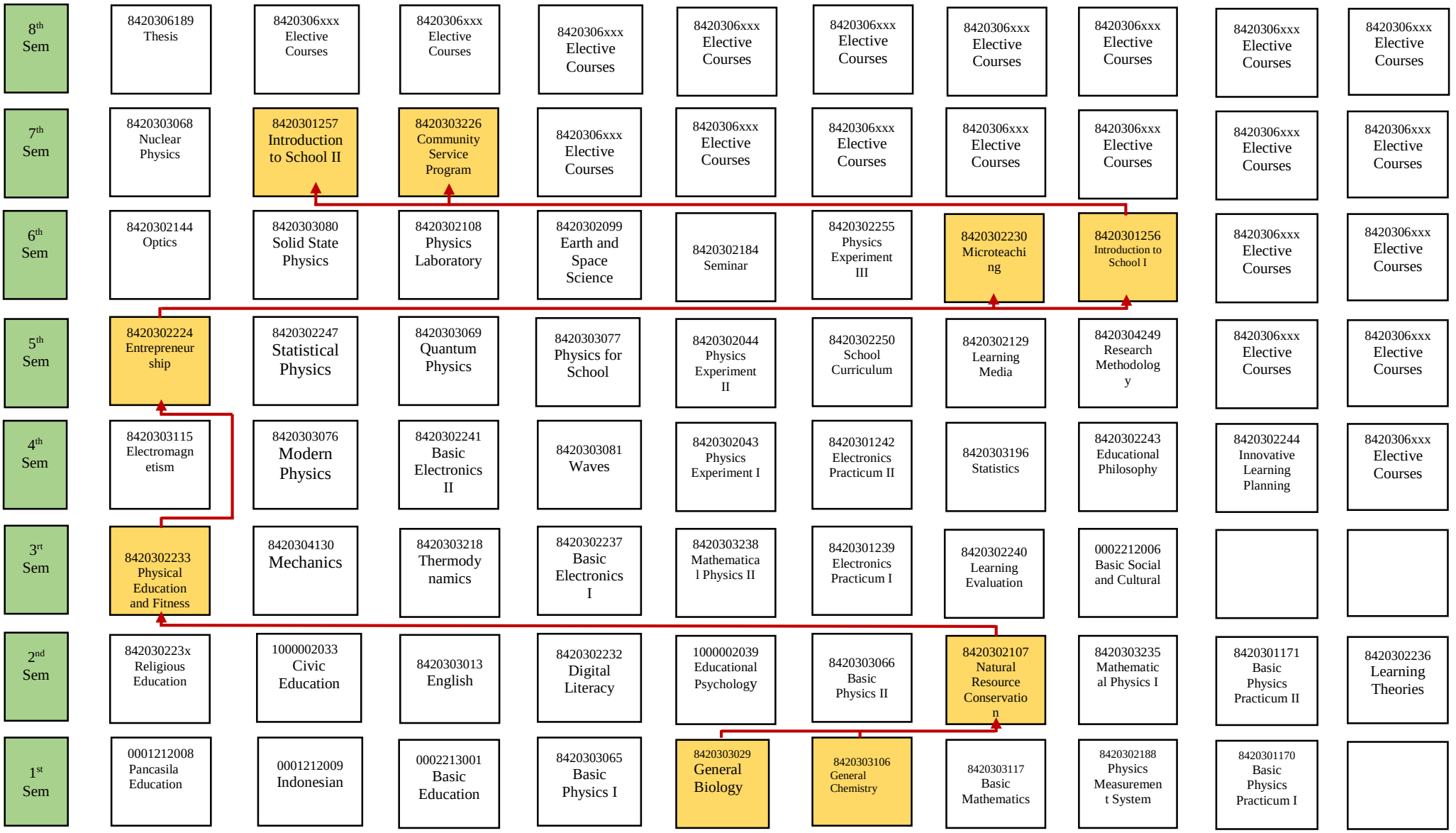


Figure 11. Course roadmap to achieve learning outcomes COM-3

Roadmap of SOC-1

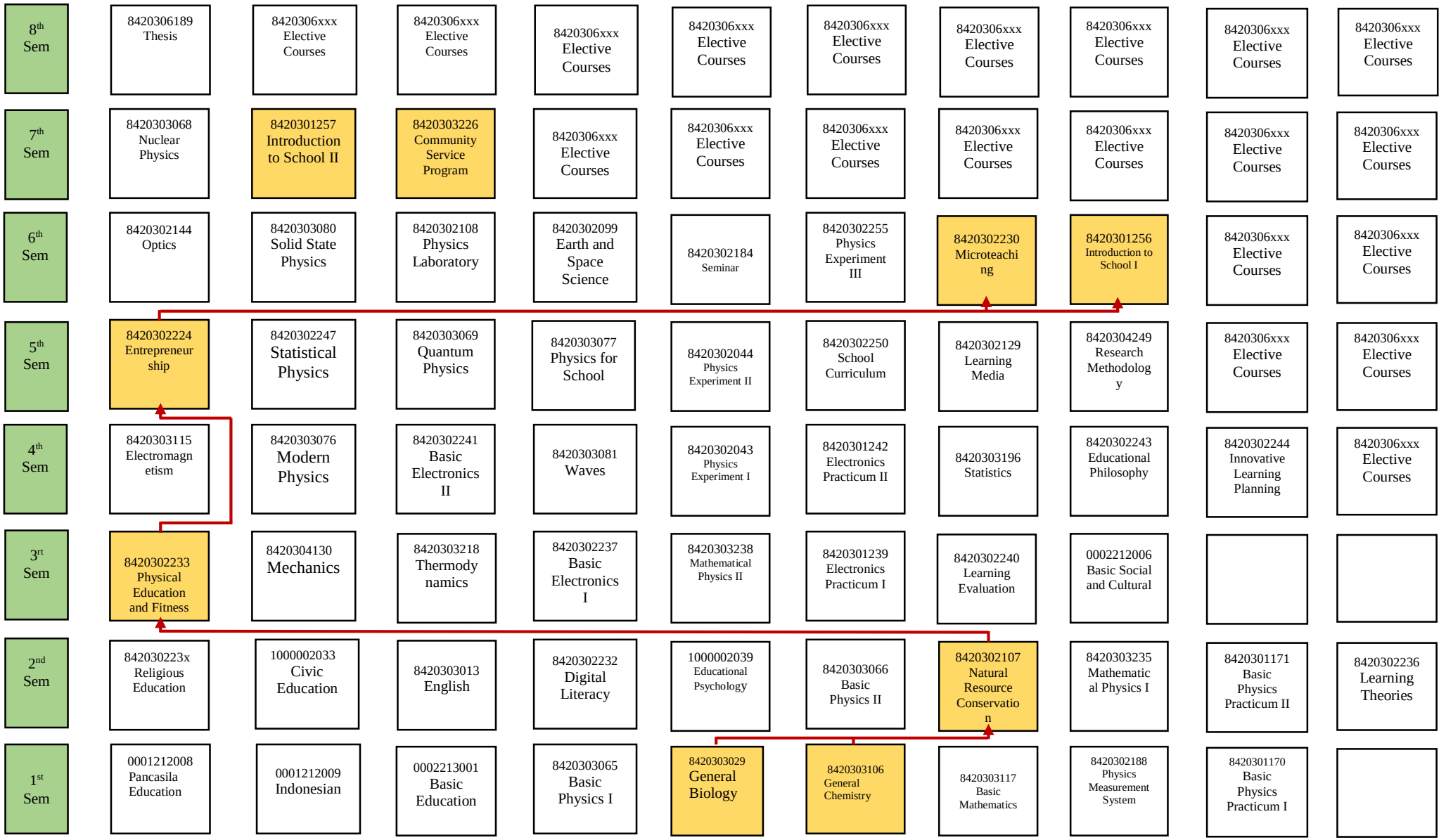


Figure 12. Course roadmap to achieve learning outcomes SOC-1

Roadmap of SOC-2

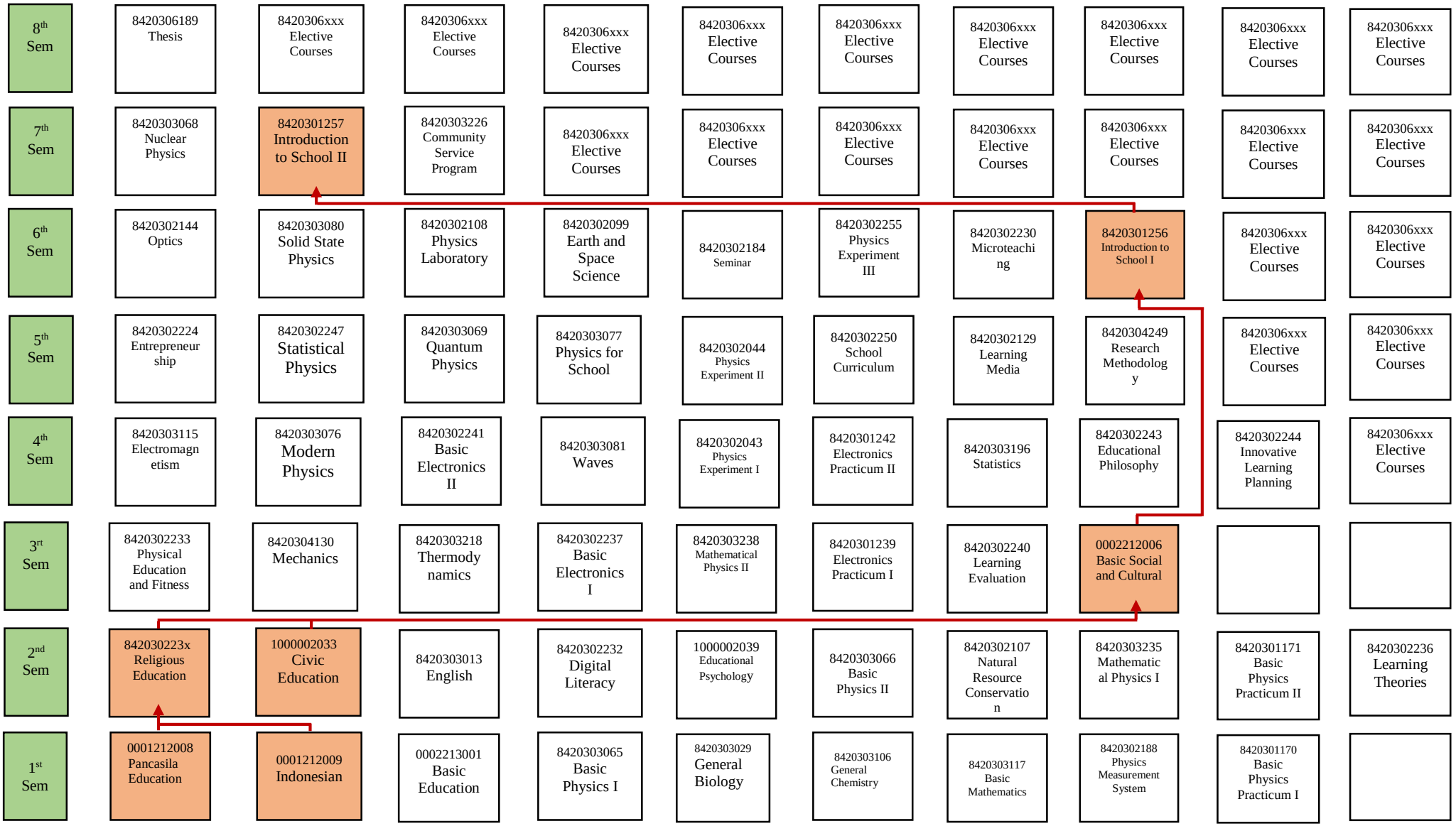


Figure 13. Course roadmap to achieve learning outcomes SOC-2