SUMMARY OF CURRICULUM

UNDERGRADUATE PROGRAMME OF MATHEMATICS EDUCATION

FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS NEGERI SURABAYA

2020

SUMMARY OF CURRICULUM

Undergraduate Program of Mathematics Education (UPME)

A. OBJECTIVES OF THE DEGREE PROGRAM

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. Organizing innovative and research-based mathematics and natural sciences education to produce graduates who are environmentally minded, entrepreneurial in spirit and have global competitiveness.
2. Conducting research of mathematics and natural science to strengthen a nationally and internationally recognized science as well as strengthen MNS education.
3. Building research-based community service to support community welfare.
4. Building a strong network of collaboration with stakeholders to improve the quality and image of FMNS.
5. Organizing autonomous, credible, fair, accountable, and transparent governance for quality assurance and quality improvement in FMNS.

Program Educational Objectives (PEO)

The demand of skills every individual need to have in 21st century encourage the designer of curriculum in any educational institution to improve the structure of curriculum so that it does not become entrenched and ritualistic, failing to respond

to changes in the world around it. In mathematics education, there is a growing interest in emphasizing problem-solving and understanding concepts over skills and procedures. Therefore, many of current curriculum are developed by incorporating the skills of underlying meanings and understanding how students work builds problem-solving skills, instead of only emphasizing memorized skills and procedures, so that they may go beyond solving the standard book chapter problem.

As mathematics education can be considered as one of the discipline of mathematics in educational view, the quality of how mathematics education, which is primarily related to the tools, methods and approaches that facilitate practice or the study of practice of teaching and learning mathematics, is studied and developed need to be improved in accordance with the effort to increase the skills associated with deeper learning, which is based on mastering skills such as analytic reasoning, complex problem solving, and teamwork.

The undergraduate program in mathematics education (UPME) at FMNS, UNESA held since 1984 base on SK of Ministry of Higher Education no 61/DIKTI/Kep/1984. This program focuses its objectives to produce graduates who can become professionals in the field of Mathematics education (Mathematics Educators, Mathematics Education Research Assistants, Edupreneur and Mathematics Education Writers) who have the following objectives.

1. Able to master knowledge in the field of mathematics and mathematics education, skills and their application in solving problems in the field of work that supports a professional career (PEO-1).
2. Responsible for understanding and applying professional ethics in carrying out duties and work (PEO-2).
3. Able to communicate and socialize in professional activities at the local, national and international level (PEO-3).
4. Able to improve self-development continuously (both formal and informal) and creatively, then become a reference in the related profession (PEO-4).

These objectives strongly support the national competences framework for undergraduate education and are consistent with the mission of FMNS and UNESA. Such a consistency is realized by producing graduates with a strong ability to comprehend and to master knowledge of the studies in mathematics and mathematics education as well as how such knowledge is applied in real-life problem. Specifically, PEO-1 supports both professional accomplishment and academic accomplishment, while PEO-2 is related to professional and social accomplishment. Likewise, PEO-3 is also related to professional and social accomplishment, while PEO-4, same with PEO-1, is related to professional and academic accomplishment.

Table 1 indicates the relationship between the objectives of the undergraduate program in Mathematics and the 6th level (the level for bachelor education) of the National Qualification Framework .

Table 1. Program Educational Objectives vs the 6th level (the level for bachelor education) of the 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	S
PEO 2	S	S	S	S
PEO 3	S	S	M	S
PEO 4	S	S	S	S

S-Strong, M-Moderate

Program Learning Outcomes (PLO)

The UPME of FMNS, Unesa sets the program learning outcomes for the graduates as presented in Table 2 as follows.

Table 2. PLO of Undergraduate Program of Mathematics Education

ASPECTS	**PLO**	**CODE**
KNOWLEDGE	Demonstrate mathematical knowledge and insight.	**KNO-1**
	Demonstrate pedagogical knowledge in designing, implementing and evaluating Mathematics' learning.	**KNO-2**
	Demonstrate knowledge related to mathematics education research	**KNO-3**
SKILL	Design, implement and evaluate mathematics' teaching and learning by using ICT	**SKI-1**
	Implement basic principle of Mathematics to solve simple Mathematics' problem	**SKI-2**
COMPETENCE	Communicate idea and research result effectively orally and literally.	**COM-1**

	Make decision based on data/information in solving task that become students' responsibility and evaluate the work that has been done.	**COM-2**
	Work effectively as individual as well as group, having enterpreneurhip spirit and environmental caring.	**COM-3**
ATTITUDES & SOCIAL	Demonstrate scientific attitude, critical and innovative in mathematics teaching and learning and professional task.	**SOC-1**
	Demonstrate religion values and cultures as well as academics etiquette in doing professional task.	**SOC 2**

In relation to how the aspects of PLO are connected with PEO, Table 3 gives an overview how strong each of PLOs supports the PEO.

Table 3. Correlation between the PEO and PLO of Undergraduate Program in Mathematics of FMNS, Unesa

	PEO			
PLO	PEO 1	PEO 2	PEO 3	PEO 4
KNO-1	S	S	S	S
KNO-2	S	S	S	S
KNO-3	S	NS	S	NS
SKI-1	S	S	NS	NS
SKI-2	S	NS	NS	S
COM-1	NS	S	S	NS
COM-2	S	S	NS	S
COM-3	NS	NS	S	S
SOC-1	NS	S	S	S
SOC-2	NS	S	S	S

S-strong, NS-not strong

B. PROGRAM STRUCTURE

1. The Curriculum

The UPME in FMNS, UNESA has a degree of Bachelor of Education (Sarjana Pendidikan or S.Pd.). This program offers courses on both Mathematics and Mathematics Education. The Mathematics courses covers some branches of Mathematics such as Analysis, Algebra, Applied Mathematics, Computational Mathematics, Combinatoric, and Geometry. Meanwhile, pedagogical courses are offered around psychology of mathematics education and learning, instructional design, and assessment in mathematics education. The curriculum is developed to

achieve the vision, carry out the mission, and achieve the goals set, and must accommodate the whole educational objectives by taking into account the characteristics of UNESA as a local learning setting that is realized in the learning outcomes of study programs. In addition, the curriculum of UPME must be able to provide a learning experience for students to achieve the expected competencies and self-development, both now and in the future. Therefore, the curriculum of the Mathematics Education Program is expected to be able to answer the demands of the needs in the field. Some of the issues considered in the preparation and development of this curriculum are as follows.

1. Indonesian National Qualification Framework (KKNI: Kerangka Kualifikasi Nasional Indonesia) and National Standards for Higher Education.
2. 21st century skills needed, namely critical thinking and problem solving, creative and innovative, communication, and collaboration.
3. The ASEAN Economic Community since 2015
4. The importance of literacy, according to Law of Ministry of Education (Permendikbud No. 23 of 2015) concerning the improvements of manners
5. The development of global community dynamics that need to be anticipated for its development to prepare reliable Indonesian human resources, such as the challenges of the ASEAN Free Trade Area (AFTA), the Word Trade Organization (WTO), and the Asia Pacific Economic Cooperation (APEC).

Furthermore, the current curriculum adopts new paradigm of education, which are out-comes based education, learner-centered learning, continuous improvement, and international benchmarking and accreditation. The mechanism of curriculum development of UPME is described as follows.

1) Forming curriculum development team in charge of producing the draft of UPME curriculum.
2) Doing self-evaluation through analysis of comparative study results, analysis of tracer study results, results of on-going curriculum evaluation, demands of the need in the field, and SWOT analysis.
3) Determining the characteristics of UPME specifications and graduate profile based on the graduate competencies formulated in PEO.
4) Determining the PLOs derived from PEO of UPME.
5) Determining study materials (based on scientific trees) and inventory of relevant essential concepts which supports each of the PLO.
6) Determining the courses/modules included in the study material and distribution of essential concepts.
7) Determining the road map of each PLO achievement by making a map of course pathways that are mutually relevant to support the achievement of each PLO from semester 1 to semester 8.
8) Estimation and determination of study load (credit unit) and preparation of course descriptions.

9) Determining the staff who teach the courses in accordance with their respective areas of expertise
10) Preparing of Module Handbook and Semester Lesson Plans by considering the relevancy of teaching methodology which support PLO achievement and how each of assessment systems (midterm exam, final exam, and assignments) correlates with PLO.

The curriculum is periodically updated every five years by following the development processes of the curriculum considering some principles of the curriculum development. This is shown in the following chart.

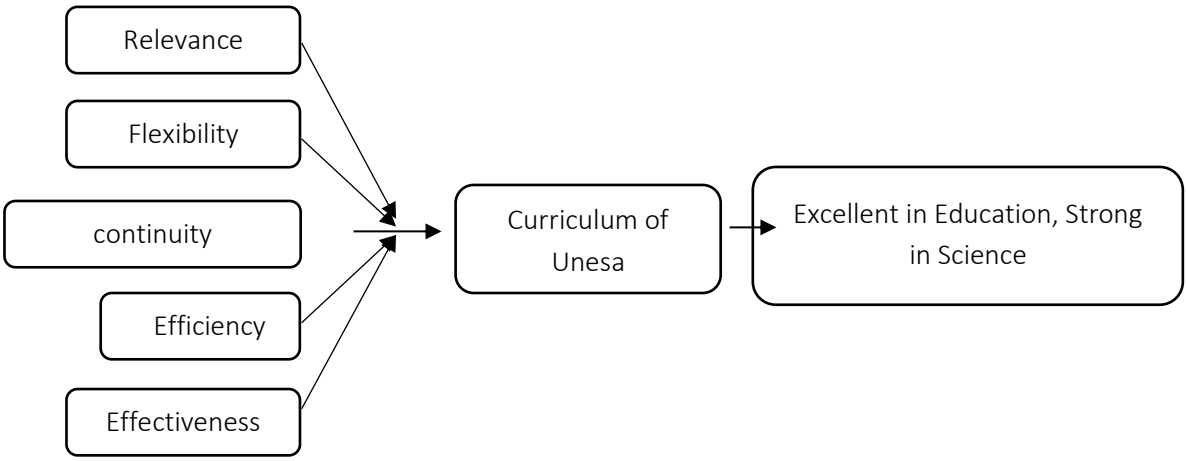


Figure 1. Principles of Curriculum Development

Based on PLO (containing four aspects, namely knowledge, skills, competencies, and social attitudes), UPME then determines what study materials should be raised so that students can achieve each of these PLOs. In determining study materials, UPME refers to several standards, namely KKNI, NCTM, OBE, Curriculum of 2013, Cambridge Curriculum, and IndoMS. The study materials identified are divided into three major groups, namely pedagogy, mathematics, and social attitudes.

- Pedagogic studies consist of mathematics teaching and learning, mathematics education research, and mathematics education theories.
- Mathematics studies consist of foundations, analysis, algebra, geometry, combinatorics and computation, applied mathematics, and statistics
- Social attitudes consist of personality and entrepreneurship.

All of those study materials are then compiled into several modules (courses) distributed in semester 1 to semester 8, so that all the materials can be accommodated. There are forty five compulsory modules (128 credits) and twenty two elective modules (54 credits) raised to support the achievement of PLOs as indicated in Table 7.

Table 7 also shows which courses that support the achievement of each

PLO. For example, to achieve a PLO (KNO-2), it requires modules in each semester are as follows.

Semester 1: Basics of Education
Semester 2: Digital Literacy, Educational Psychology, Learning Theories
Semester 3: Innovative Learning I, Contextual Mathematics, History of Mathematics
Semester 4: Assessment, Learning Media, Innovative Learning II, Visual Programming*), Psychology of Mathematics Learning*)
Semester 5: School Mathematics, Curriculum Analysis, E-Learning*), Reasoning and Proof*)
Semester 6: Philosophy of Mathematics Education, Mathematics Education Seminar, Problem Solving
Semester 7: Thesis
Semester 8: Ethnomathematics*)

*) elective module

The PLOs of UPME are closely related to specialist learning outcomes for Bachelor degree programmes created by ASIIN (SSC-12: iM). It can be seen in the following table.

Table 4. Specialist learning outcomes for Bachelor degree programmes created by ASIIN (SSC-12: iM) and UPME PLO

SSC-12: iM	PLO									
	KNO-1	KNO-2	KNO-3	SKI-1	SKI-2	COM-1	COM-2	COM-3	SOC-1	SOC-2
Able to formulate simple mathematical problems										
Able to solve simple practical problems by applying fundamental mathematical methods (where applicable only with software)										

Able to allocate practical problems to a mathematical category										
Master in fundamental strategies for transferring methods in selected areas of Mathematics, depending on the practical application										
Create simple, realistic mathematical problems under supervision										

C. WORKLOAD AND CREDITS

The determination of credit units for courses follows the rules contained in the UNESA academic manuscript, which is based on the time required by students to achieve certain competencies through learning schemes and certain study materials by following formulas.

$$CU = \frac{1T + \frac{1}{2}P + \frac{1}{4}L}{16 \times 60}$$

where

T (Theory): the periods of learning experience obtained from learning with an expository approach, which one-hour face-to-face equivalent to 50 minutes.

P (Practice): the periods of learning experience obtained through a series of practicum processes, appreciation, modelling, simulation, which one-hour face-to-face equivalent to 100 minutes.

L (Field): the periods of learning experience obtained through direct practice in real situations and conditions in the field or community, which one-hour face-to-face equivalent to 200 minutes.

As an example of determining the number of credits for the Multivariable Calculus course is follows.

Table 5. Examples of Credits for Multivariable Calculus

Materials	Time required (minutes)			CU
	T	**P**	**L**	
Vector in R^2 dan R^3	400	0	0	3.875 ≈ 4
Limit and Continuity of Vector-Valued Function	200	0	0	
Derivative of Vector-Valued Function	60	0	0	
Integral of Vector-Valued Function	400	0	0	
Limit and Continuity of Multivariable Function	200	0	0	
Derivative of Multivariable Function	300	0	0	
Critical values of Multivariable Function	400	0	0	
Double Integral and Its Application	300	0	0	
Triple Integral and Its Application	300	0	0	

The learning programme of UPME uses a semester credit system (CU) where in one academic year it consists of two semesters, each entails 14 weeks. In one semester, the study load of each student ranges from 18 to 20 CU. One credit unit entails three types of activity per week for one semester. These activities are 50 minutes face-to-face (teaching and learning in class), 60 minutes of structured activities outside the classroom, such as doing assignments from lecturers, and 60 minutes of independent activities outside the classroom. Therefore, the student learning load for 1 credit is equivalent to 1.59 ECTS. The maximum total number of credits can be taken by student is 160 credits or equivalent to 254.4 ECTS. In order to graduate from this study programmes, a student should meet a minimum of 144 credits or equivalent to 228.96 ECTS. Moreover, the calculation of the ECTS value is given as follows:

$$K = \frac{pxqxr}{25},$$

where,

K = ECTS value

p = Total credit

q = Total hours per credit

r = Total week per semester

To complete the learning program, students should take 144 credit units (CU) comprising 128 CU compulsory courses and 16 CU elective course.

Table 6. Distribution of Credit Units for UPME Courses/Modules

CU compulsary courses	CU	Note
CU of compulsary courses	128	The CU courses are distributed into 128 course units distributed into 45 compulsory courses.
CU of elective courses	16	There are 54 CU from 22 elective courses
Total	144	

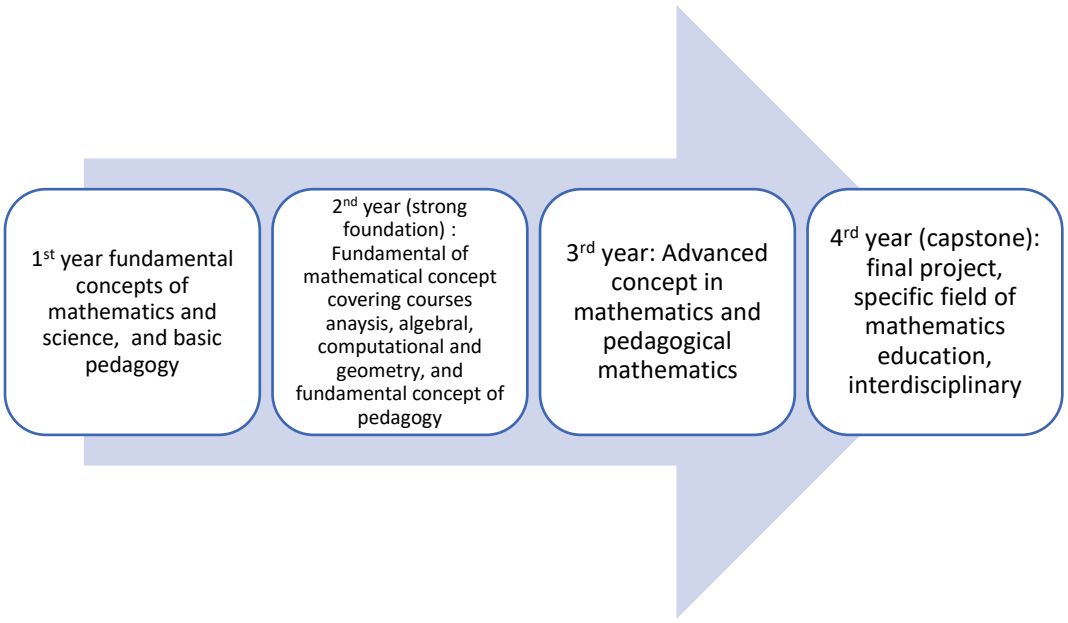


Figure 2. Model of Curriculum Structure of Undergraduate Program in Mathematics Education

The detailed curriculum structure of the undergraduate program in Mathematics and list of elective course are shown in Table 3-5.

2. Program Structure

Figure 3 and Table. 7 respectively shows the mapping of the courses that support the program learning outcomes (PLO).

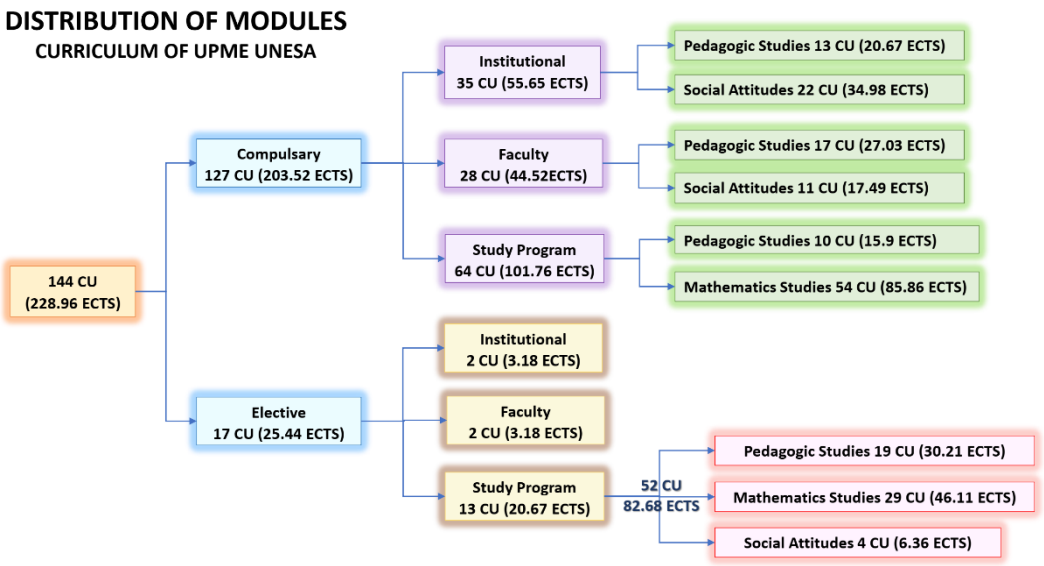


Figure 3. Distibution of Modules

Table 7. Mapping of the Courses that Support the Program Learning Outcomes (PLO)

No	Code	Module	C U	ECTS	KNO-1	KNO-2	KNO-3	SKI-1	SKI-2	COM-1	COM-2	COM-3	SOC-1	SOC-2
1st Semester														
1	8420203043	Foundations of Mathematics	3	4.77	√				√					
2	8420204079	Differential Calculus	4	6.36	√				√					
3	1000002003	Indonesian	2	3.18						√				
4	8420203036	General Biology	3	4.77									√	
5	8420203061	General Physics	3	4.77									√	
6	8420203089	General Chemistry	3	4.77									√	
7	1000003006	Basics of Education	3	4.77		√								
8	1000002018	Pancasila	2	3.18										√
2nd Semester														
9	100000202x	Religion Education	2	3.18										√
10	1000002033	Citizenship Education	2	3.18										√

No	Code	Module	C U	ECTS	KNO-1	KNO-2	KNO-3	SKI-1	SKI-2	COM-1	COM-2	COM-3	SOC-1	SOC-2
11		Digital Literacy	2	3.18		√		√			√			
12	8420203064	Geometry	3	4.77	√				√					
13	8420204083	Integral Calculus	4	6.36	√				√					
14	8420203020	English	3	4.77						√			√	
15	8420202094	Conservation of Natural Resources and Environment	2	3.18								√		√
16	1000002039	Educational Psychology	2	3.18		√								
17	8420203219	Learning Theories	3	4.77		√								
3rd Semester														
18	8420203007	Elementary Linear Algebra	3	4.77	√				√					
19	8420203065	Analytical Geometry	3	4.77	√				√					
20	8420203127	Statistic Method	3	4.77	√				√					
21	8420202222	Elementary Number Theory	3	4.77	√				√					
22	8420203144	Innovative Learning I	3	4.77		√		√		√			√	
23		Physical Education	2	3.18										√
24	8420202110	Contextual Mathematics*)	2	3.18		√		√		√	√		√	
25	8420202197	History of Mathematics*)	2	3.18		√		√			√			
26	1000002011	Basic Social and	2	3.18										√

No	Code	Module	C U	ECTS	KNO-1	KNO-2	KNO-3	SKI-1	SKI-2	COM-1	COM-2	COM-3	SOC-1	SOC-2
		Cultural Studies*)												
4th Semester														
27	8420203010	Abstract Algebra I	3	4.77	√				√					
28	8420203013	Real Analysis I	3	4.77	√				√					
29	8420203107	Discrete Mathematics	3	4.77	√				√					
30	8420203193	Operation Research	3	4.77	√				√					
31	8420203018	Assessment	3	4.77		√		√		√				
32	8420202121	Learning Media	2	3.18		√		√			√		√	
33	8420203146	Innovative Learning II	3	4.77		√		√		√			√	
34	8420203152	Visual Programming*)	3	4.77		√		√			√			
35	8420202186	Psychology of Mathematics Learning*)	2	3.18		√		√			√			
5th Semester														
36	8420204085	Multivariable Calculus	4	6.36	√				√					
37	8420203111	School Mathematics	3	4.77		√		√		√	√		√	
38	8420203217	Curriculum Analysis	3	4.77		√		√		√	√		√	
39		Education Research Methodology	3	4.77			√	√		√	√			
40	8420202142	Probability and Statistics	3	4.77	√				√					
41	8420202047	E-Learning*)	2	3.18		√		√					√	
42	8420202153	Reasoning and Proof*)	2	3.18	√	√			√					
43	8420203201	System of	3	4.77	√				√					

No	Code	Module	C U	ECTS	KNO-1	KNO-2	KNO-3	SKI-1	SKI-2	COM-1	COM-2	COM-3	SOC-1	SOC-2
		Geometry*)												
44	8420202004	Entrepreneurship *)	2	3.18				√		√	√	√	√	
6th Semester														
45	8420202057	Philosophy of Mathematics Education	2	3.18	√	√		√						
46	8420203123	Numerical Methods	3	4.77	√				√					
47	8420203173	Ordinary Differential Equation	3	4.77	√				√					
48	8420202200	Mathematics Education Seminar	2	3.18		√	√			√	√		√	√
49	8420202004	Microteaching	2	3.18				√		√	√		√	
50	8420203067	Transformational Geometry*)	3	4.77	√				√					
51	8420202148	Problem Solving*)	2	3.18	√	√					√			
52	8420202169	Academic Writing*)	2	3.18				√		√	√		√	
7th Semester														
53	8420206202	Thesis	6	9.54	√	√	√	√		√	√		√	√
54	8420203004	Teaching Internship	4	6.36				√					√	
55	8420203096	Community Service	3	4.77				√		√	√		√	√
56	8420203149	Mathematical Modelling	3	4.77	√				√					
57	8420202093	Public Communication *)	2	3.18						√				
58	8420203221	Number Theory*)	3	4.77	√				√					

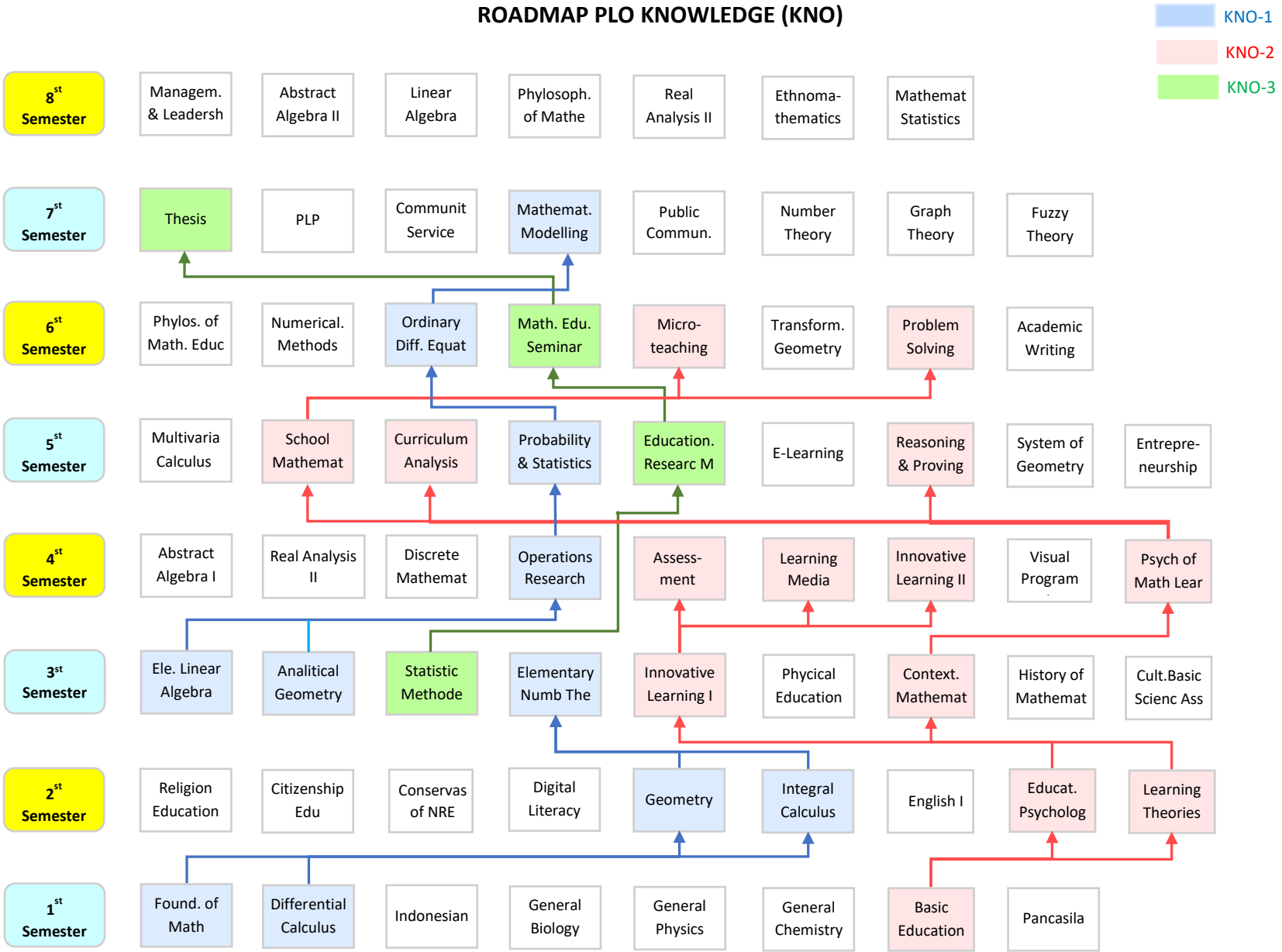
No	Code	Module	C U	ECTS	KNO-1	KNO-2	KNO-3	SKI-1	SKI-2	COM-1	COM-2	COM-3	SOC-1	SOC-2
59	8420203224	Graph Theory*)	3	4.77	√				√					
60	8420203223	Fuzzy Theory*)	3	4.77	√				√					
8th Semester														
61	8420202105	Management and Leadership*)	2	3.18								√	√	
62	8420203005	Abstract Algebra II*)	3	4.77	√			√						
63	8420203006	Linear Algebra*)	3	4.77	√			√						
64	8420202056	Philosophy of Mathematics*)	2	3.18	√					√				
65	8420203012	Real Analysis II*)	3	4.77	√				√					
66	8420202052	Ethnomathematics*)	2	3.18		√		√		√			√	
67	8420203206	Mathematical Statistics*)	3	4.77	√				√					

Table 2.4. List of Elective Modules

Odd Semester					**Even Semester**				
No	Code	Module	CU	ECTS	No	Code	Module Title	CU	ECTS
1	8420202093	Public Communication	2	3.18	1	8420202105	Management and Leadership	2	3.18
2	8420202047	E-Learning	2	3.18	2	8420203005	Abstract Algebra II	3	4.77
3	8420202110	Contextual Mathematics	2	3.18	3	8420203006	Linear Algebra	3	4.77
4	8420202153	Reasoning and Proof	2	3.18	4	8420202056	Philosophy of Mathematics	2	3.18
5	8420202197	History of Mathematics	2	3.18	5	8420203067	Transformational Geometry	3	4.77

6	8420203201	System of Geometry	3	4.77	6	8420203152	Visual Programing	3	4.77
7	8420203221	Number Theory	3	4.77	7	8420202169	Academic Writing	2	3.18
8	8420203224	Graph Theory	3	4.77	8	8420202186	Psychology of Mathematics Learning	2	3.18
9	8420203012	Real Analysis II	3	4.77	9	8420202052	Ethnomathematics	2	3.18
10	8420203223	Fuzzy Theory	3	4.77	10	8420203206	Mathematical Statistics	3	4.77
11	8420202004	Entrepreneurship	2	3.18	11	8420202148	Problem Solving	2	3.18
12	1000002011	Basic Social and Cultural Studies	2	3.18					

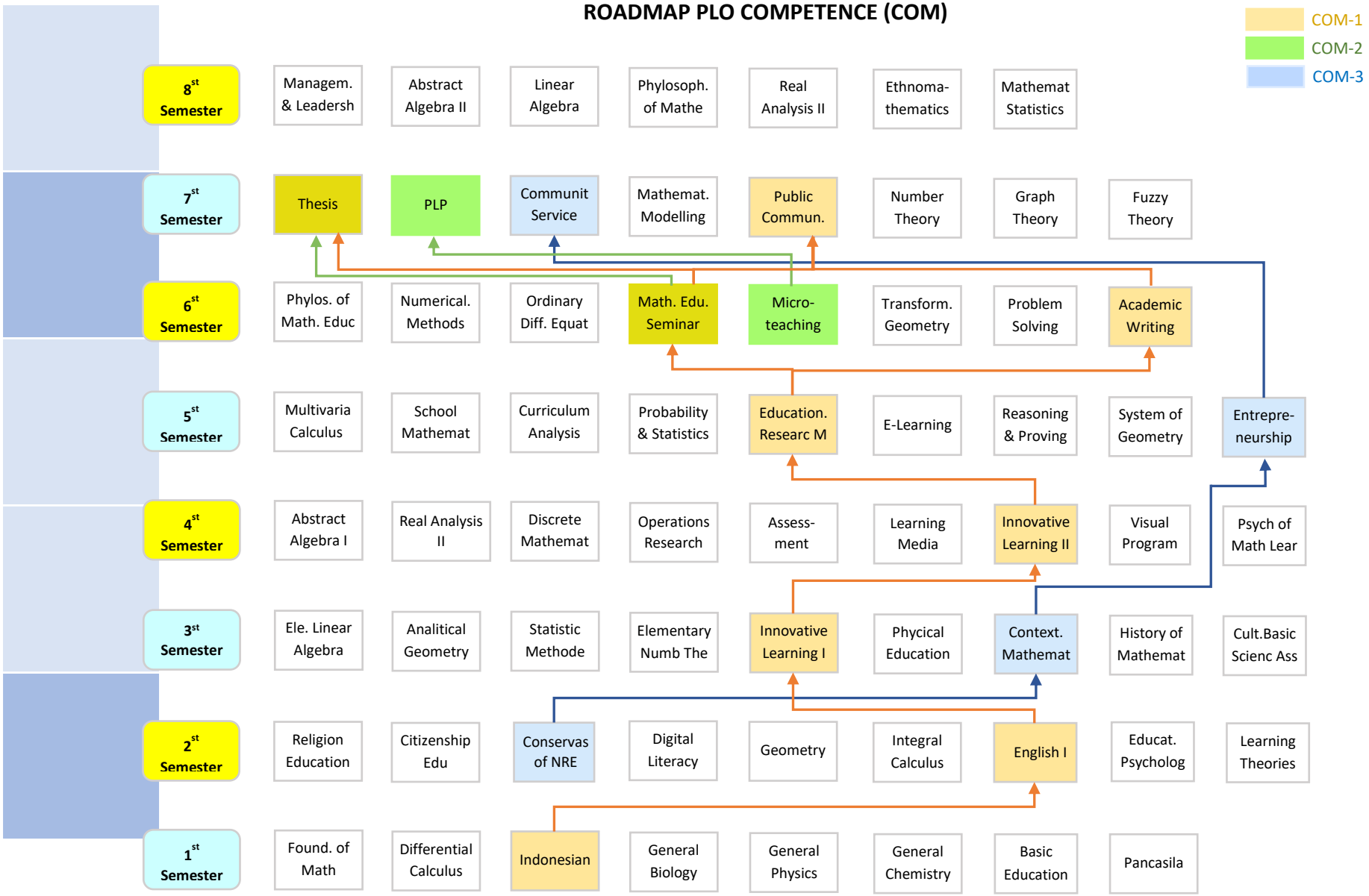
ROADMAP PLO KNOWLEDGE (KNO)



ROADMAP PLO SKIIL (SKI)



ROADMAP PLO COMPETENCE (COM)



ROADMAP PLO SOCIAL (SOC)

