

UNDERGRADUATE PROGRAM IN MATHEMATICS

*(Issued together with the Decision No /QĐ-KHTN dated December 31 , 2020
of the Rector of the University of Science)*

- Name of Program: **Bachelor of Science in Mathematics**
- Training degree: **Bachelor of Science**
- Education major: **Mathematics**
- Sector code: **7460101**
- Course: **2019**

1. PROGRAM OBJECTIVES

a. General objective:

- The program aims to train undergraduate students whose command of mathematics is comparable nationally and internationally, whose ability is appropriate to current needs of society at local, national, and international levels

b. Specific goals/output standards of the educational program:

- [LO1] General education outside the field: Generalizing and applying the general knowledge of politics - economy - society - natural sciences - study skills - foreign languages - physical;
- [LO2] General professional education: Achieved required competency in multivariable calculus, linear algebra, introductory algebraic structures, basic analysis on metric and normed spaces, solving concrete differential equations and mathematical models, introductory mathematical softwares, and introductory computer programming;
- [LO3] Foundational professional education: Achieved required competency in at least one of the following Concentrations: Mathematics, Computer Science, Quantitative Finance, Mathematical Education, through required courses of the concentration;
- [LO4] Professional education: Achieved in-depth knowledge through required and optional courses of at least one Specialization of the Concentration. Qualified students are allowed to take a seminar course and to compose a graduation thesis;
- [LO5] Broad and auxiliary education: complete a mandatory number of courses outside of the Specialization and a minimum number of credits;
- [LO6] Computer skills: Able to utilize to communicate, to search, to access information and study resources, able to compose mathematical texts in accordance with professional practice, command at least one programming language;
- [LO7] Professional communication skills: experienced project writings and presentations;

- [LO8] Foreign language skill: achieved university's required competency in English language, able to utilize professional documentation in English, some students experienced professional classes studied in English;
- [LO9] Soft skills: acquired skill, habit, and inner resource for self-study, social communication, group work. Participated in professional and extra-curricular activities;
- [LO10] Way of thinking: developed rigorous, precise, reflective thinking; independent and creative mind; social consciousness; realization of roles of mathematics and computer science in life; figuring one own place in society.

c. Career opportunities

- The Mathematics concentration aims to provide to students a solid mathematical foundation in algebra, analysis, probability statistics, and computer science, that students following in each specialization can be relatively classified into theoretical mathematics (algebra, calculus) or applied mathematics (numerical analysis, mechanics, optimization, statistical probability) (each with more theoretical or more applied fields).

Career areas include:

- + Teaching and researching mathematics at universities, colleges, cultural centers, research centers.
- + Working at technology enterprises, research and development.
- + Working in the fields of science, engineering, economics, management, ... that need the ability to analyze, handle highly complex problems and can use mathematical tools and methods.
- The Computer science concentration aims to provide students a background in computer science, programming, and mathematical tools, helping students to enter the specialization of Mathematical methods in computer science (focus the use of computer tools and mathematical methods in computer science), Applied mathematical computer science (focus on engineering applications, technology, programming), Data Science (combining computer science and statistics to process big data).

Career areas include:

- + Doing research and teaching at universities, colleges, research centers, research units of technology enterprises, etc in the field of mathematics and computer science, information technology.
- + Working at trading companies, manufacturing enterprises to design, build, operate and exploit information systems.
- + Work at software companies as an analyst or programmer.
- The Quantitative Finance concentration trains bachelors with a solid background in mathematics and computer science, broad knowledge of economics and deep enough on the use of quantitative financial tools, and the ability to research and analyze and financial consultancy on the base of application of mathematical methods, data processing and modern computing techniques.

Career areas include:

- + Work in financial companies, joint-stock companies, insurance companies, commercial banks, investment funds.
- + Work as managers in state agencies.
- + Teaching universities and colleges.
- The Mathematical Education concentration aims to train bachelors with specialized knowledge in mathematics and computer science, educational sciences and pedagogy, with proficient practical

skills, good thinking ability, and good thinking ability, to be able to work independently, creatively, with a sense of professional ethics.

Career areas include:

- + Teaching at professional and vocational secondary schools, cultural training centers, education companies.
 - + Teaching at universities and colleges (if continuing to study at graduate level).
 - + Teaching at high schools (if it meets the requirements of employers, the Faculty of Mathematics and Computer Science does not issue "pedagogical certificates")
 - + Do educational management.
- Mathematics curriculum is highly integrated, students are obligated and free to choose from different concentrations and specializations, thereby accessing career opportunities from other directions. Qualified and aspirational students can continue their postgraduate studies in graduate programs of the Faculty of Mathematics and Computer Science or elsewhere.

2. TRAINING TIME: 4 years

3. KNOWLEDGE VOLUME: 131 credits

4. ADMISSION RULE

According to the Regulation on enrollment of regular universities and colleges of the Ministry of Education and Training and the Vietnam National University in Ho Chi Minh City.

5. TRAINING PROCESS, GRADUATION CONDITIONS

- a) **Training process:** Pursuant to the Academic Regulations on regular university and college training according to the credit system issued together with Decision No. 1227/QD-KHTN dated July 12, 2018 of the Rector of the University Faculty of Natural Sciences, VNU-HCM.
- b) **Graduation conditions:** accumulate a sufficient number of credits of general education and professional education as described in Sections 6 and 7 of this Curriculum, and satisfy the conditions in Article 28 of the Regulations. Academic training in universities and colleges under the credit system issued together with Decision No. 1227/QD-KHTN dated July 12, 2018 of the Rector of the University Science, VNU-HCM

6. PROGRAM STRUCTURE

No	KNOWLEDGE MODULE	NUMBER OF CREDITS			Total credits accumulated credits for graduation (1+2+3+4)		
		Required	Optional	Total			
I	General Education (Excluding National Defense Education, English, Basic Computer, Physical Education) (1)	Required	Optional	Total			
		46	8	54			
II	Professional Education	Foundation in Concentrations (2)		Required	Optional	Total	
		1	Mathematics Concentration	15	4	19	
		2	Computer Science Concentration	15	4	19	

	3	Mathematical Education Concentration	18	0	18	
	4	Quantitative Finance Concentration	15	0	15	
	Specialization (3)		Required	Optional	Total	
	1	Mechanics (Mathematics concentration)	16	32	48	131
	2	Algebra (Mathematics concentration)	16	32	48	131
	3	Analysis (Mathematics concentration)	16	32	48	131
	4	Numerical Analysis (Mathematics concentration)	16	32	48	131
	5	Optimization (Mathematics concentration)	15	33	48	131
	6	Probability and Statistics (Mathematics concentration)	16	32	48	131
	7	Data Science (Computer Science concentration)	23	25	48	131
	8	Mathematical Methods in Computer Science (Computer Science concentration)	16	32	48	131
	9	Applied Mathematical Computer Science (Computer Science concentration)	15	33	48	131
	10	Didactics and Methodology of Mathematics Teaching (Mathematical Education concentration)	20	29	49	131
	11	Financial Mathematics (Quantitative Finance concentration)	20	32	52	131
	Graduating works (4)		10			

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7. CONTENT OF PROGRAM

Course type convention:

- Required: R
- Optional: O

7.1. GENERAL CURRICULUM

Accumulate a total of **54** credits (excluding National Defense Education, English, Basic Computer and Physical Education):

7.1.1. Political theory - Law

No	CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type	Note
				Theory	Practice	Exercise			
1	BAA00101	Marxist-Leninist philosophy	3	45	0	0	4.5	R	
2	BAA00102	Marxist-Leninist political economics	2	30	0	0	3	R	
3	BAA00103	Science socialism	2	30	0	0	3	R	
4	BAA00104	History of the Communist Party of Vietnam	2	30	0	0	3	R	
5	BAA00003	Ho Chi Minh's ideology	2	30	0	0	3	R	
6	BAA00004	Introduction to the system of laws of Vietnam	3	45	0	0	4.5	R	
TOTAL			14				21		

7.1.2. Socio-economic courses

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type	Note
				Theory	Practice	Exercise			
1	BAA00005	Introduction to economics	2	30	0	0	3	O	Select 1 of 3 courses
2	BAA00006	Introduction to Psychology	2	30	0	0	3	O	
3	BAA00008	Teamworking and learning skills	2	30	0	0	3	O	
TOTAL			2				3		

7.1.3. Foreign Language

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type	Note
				Theory	Practice	Exercise			
1	BAA00011	English 1	3	30	30	0	5	R	
2	BAA00012	English 2	3	30	30	0	5	R	

3	BAA00013	English 3	3	30	30	0	5	R	
4	BAA00014	English 4	3	30	30	0	5	R	

7.1.4. Mathematics – Informatics – Natural Sciences

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type	Note
				Theory	Practice	Exercise			
1	MTH00010	Analysis 1A	3	30	0	30	5	R	
2	MTH00011	Calculus 1A	3	30	0	30	5	R	
3	MTH00012	Analysis 2A	2	30	0	0	3	R	
4	MTH00013	Calculus 2A	3	30	0	30	5	R	
5	MTH00014	Analysis 3A	4	45	0	30	5.5	R	
6	MTH00015	Analysis 4A	3	45	0	0	4.5	R	
7	MTH00030	Linear algebra	3	45	0	0	4.5	R	
8	MTH00031	Higher algebra	3	45	0	0	4.5	R	
9	MTH00055	Foundations of computer programming	4	45	30	0	4.5	R	
10	MTH00083	Computer Lab for Linear Algebra	1	0	30	0	2	R	
11	MTH00084	Computer Lab for Advanced Algebra	1	0	30	0	2	R	
12	MTH00087	Lad-course for Softwares of Computing	2	0	60	0	4	R	
Select 1 course in optional group 2 (O2)									
13	ENV00001	Introduction to environmental studies	2	30	0	0	3	O2	
	ENV00003	Human and the environment	2	30	0	0	3	O2	
	GEO00002	Earth sciences	2	30	0	0	3	O2	
Select 4 credits in optional group 3 (O3)									
	CHE00081	Laboratory of basic Chemistry 1	2	0	60	0	44	O3	
	CHE00082	Laboratory of basic Chemistry 2	2	0	60	0	4	O3	
	BIO00001	Basic Biology 1	3	45	0	0	4.5	O3	
	BIO00002	Basic Biology 2	3	45	0	0	4.5	O3	
	BIO00081	Laboratory of basic Biology 1	1	0	30	0	2	O3	
	BIO00082	Laboratory of basic Biology 2	1	0	30	0	2	O3	

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type	Note
				Theory	Practice	Exercise			
	PHY00001	Basic Physics 1 (Mechanics and Thermodynamics)	3	45	0	0	4.5	O3	
	PHY00002	Basic Physics 2 (Electrodynamics-Optics)	3	45	0	0	4.5	O3	
	PHY00081	Laboratory of basic Physics	2	0	60	0	4	O3	
TOTAL			38						

7.1.5. Physical education and defense education

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type	Note
				Theory	Practice	Exercise			
1	BAA00021	Gymnastics 1	2	15	30	0	3.5	R	
2	BAA00022	Gymnastics 2	2	15	30	0	3.5	R	
3	BAA00030	National Defense Education	4				8	R	
TOTAL			8				15		

7.1.6. Basic Informatics

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type	Note
				Theory	Practice	Exercise			
1	CSC00003	Basic Informatics	3	15	60	0	5.5	R	

7.2. PROFESSIONAL EDUCATION KNOWLEDGE

The General Curriculum contains basic knowledge and fundamentals for the Foundations in Concentrations, the Specializations and the Graduating works:

- Basic knowledge and fundamentals for the Foundations in Concentrations: including required courses.
- Basic knowledge and fundamentals for the Specializations: including required courses by each specialization and optional courses corresponding to this specialization. Students make a decision of choosing one specialization, which is the specialization for graduation.
- Basic knowledge and fundamentals for Graduating works: students are able to make a decision to complete a thesis associating with the specialization for graduation, or to complete other specific courses instead.

7.2.1. Basic knowledge and fundamentals for the Foundations in Concentrations: including required courses.

7.2.1.1. The Mathematics Concentration contains the following specializations: **Mechanics, Algebra, Analysis, Numerical Analysis, Optimization, Probability and Statistics.**

a. Required courses: students accumulate the following 4 courses (15 credits).

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10401	Measure Theory and Probability	4	45	0	30	6.5	R
2	MTH10402	Algebra A2	4	45	30	0	6.5	R
3	MTH10403	Functional Analysis	4	45	0	30	6.5	R
4	MTH10404	Mathematical Statistics	3	15	30	30	5.5	R
TOTAL			15				25	

b. Optional courses: students accumulate 01 course (4 credits) in the following list.

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10405	Data Structure and Algorithm	4	45	30	0	6.5	O
2	MTH10406	Discrete Mathematics	4	45	30	0	6.5	O
3	MTH10407	Object Oriented Programming	4	45	30	0	6.5	O
TOTAL			4				6.5	

7.2.1.2. The Computer Science Concentration contains the following specializations: **Data Science, Mathematical Methods in Computer Science, Applied Mathematical Computer Science.**

a. Required course: students accumulate the following 4 courses (15 credits).

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10404	Mathematical Statistics	3	15	30	30	5.5	R
2	MTH10405	Data Structure and Algorithm	4	45	30	0	6.5	R
3	MTH10406	Discrete Mathematics	4	45	30	0	6.5	R
4	MTH10407	Object Oriented Programming	4	45	30	0	6.5	R
TOTAL			15				25	

b. Optional course: students accumulate 01 course (4 credits) in the following list.

No	COURSE CODE	COURSE NAME	No of credits	Number of Periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10401	Measure Theory and Probability	4	45	0	30	6.5	O
2	MTH10402	Algebra A2	4	45	30	0	6.5	O
3	MTH10403	Functional Analysis	4	45	0	30	6.5	O
TOTAL			4				6.5	

7.2.1.3. The Mathematical Education Concentration contains the following specialization: **Didactics and Methodology of Mathematics Teaching**.

Required courses: students accumulate the following 5 courses (18 credits).

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10110	Methods of teaching Mathematics 1	3	30	30	0	5	R
2	MTH10111	Methods of teaching Mathematics 2	3	30	30	0	5	R
3	MTH10401	Measure Theory and Probability	4	45	0	30	6.5	R
4	MTH10402	Algebra A2	4	45	30	0	6.5	R
5	MTH10403	Functional Analysis	4	45	0	30	6.5	R
TOTAL			18				29.5	

7.2.1.4. The Quantitative Finance Concentration contains the following specialization: **Financial Mathematics**.

Required courses: students accumulate the following 4 courses (15 credits).

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10401	Measure Theory and Probability	4	45	0	30	6.5	R
2	MTH10402	Algebra A2	4	45	30	0	6.5	R
3	MTH10403	Functional Analysis	4	45	0	30	6.5	R
4	MTH10404	Mathematical Statistics	3	15	30	30	5.5	R
TOTAL			15				25	

7.2.2. Basic knowledge and fundamentals for the Specializations: for each specialization, there are required courses by the specialization, optional courses by the specialization and other optional (no requirement by the specialization, i.e. free-to-choose) courses.

- **Required/optional courses associating to the specialization for graduation:**

In order to graduate with a specialization, students make a decision to choose a specific specialization for graduation. For the specialization of graduation, each student selects certain courses from the list of required/optional courses corresponding to his/her specialization.

- **Other optional (no requirement by the specialization, i.e. free-to-choose) courses:**

Students have to select these other optional courses so that the total number of credits required for the entire undergraduate study reaches at least **131** credits according to the Program Structure in section 6 (excluding National Defense Education, Foreign Language, Basic Computer and Physical Education). Moreover, these other optional courses must satisfy the following requirements:

1. Choose at least 02 courses (corresponding from 06 credits to 08 credits) from the list of required/optional courses corresponding to another specialization different from the specialization

of graduation (courses not on the list of required/optional courses corresponding to the Foundations in Concentration of graduation as well as not on the list corresponding to the specialization of graduation). Each student can choose 2 courses in the same specialization or in two different ones.

2. The remaining optional credits (when all the requirements mentioned above are already verified) are selected as follows:

- General optional courses that are not part of the specialization mentioned in Section 7.2.3;
- Other optional (no requirement by the specialization, i.e. free-to-choose) courses in any specialization.
- Required/optional courses corresponding to Foundations in Concentration.
- Required/optional courses corresponding to Specializations.

Note:

* Regarding the registration for the course “Seminar”, the requirements are:

- Each student have GPA of **6.5** at least;
- Each student can only choose **1** seminar course that is obligatory associated with the specialization for graduation; other extra seminar courses will be canceled;
- Each student has a form of registration for the course "Seminar" and must be approved by the Faculty of Mathematics and Computer Science.

* Regarding the registration for the course “Graduation Thesis”, the requirements are:

- Each student has passed and accumulated at least 56 credits;
- Each student has a GPA of **7.0** at least;
- Each student has passed the general required courses by the Foundations in Concentration as well as the required courses corresponding to the specialization for graduation;
- Each student has a form of registration to work on a "Graduation Thesis" associated with the specialization for graduation and must be approved by the Faculty of Mathematics and Computer Science.

* Regarding the registration for the course "Internship of Practical Project", the requirements are: each student has a form of registration for the course “Internship of Practical Project” and must be approved by the Faculty of Mathematics and Computer Science.

7.2.2.1. Specialization in Mechanics

a. Required courses by specialization: students select 4 courses from the list of specialization below to pass and accumulate in total of **16 credits at least**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10410	Numerical Analysis 1	4	45	30	0	6.5	O
2	MTH10413	Equations of Mathematical Physics	4	60	0	0	6	O
3	MTH10427	Theoretical Mechanics	4	60	0	0	6	O
4	MTH10428	Continuum Mechanics	4	60	0	0	6	O
5	MTH10429	Finite element method	4	45	30	0	6.5	O
6	MTH10412	Complex variable functions	4	60	0	0	6	O
7	MTH10434	Solids Mechanics	4	60	0	0	6	O
8	MTH10435	Fluid Mechanics	4	60	0	0	6	O

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
TOTAL			16				24	

- b. Optional courses: students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10430	Vibration and Stability Theory	4	60	0	0	6	O
2	MTH10520	Seminar on Mechanics	4	60	0	0	6	O
3	MTH10521	Finite difference methods	2	30	0	0	3	O
4	MTH10524	Dynamics of multibody and Robotics	4	45	3 0	0	6.5	O
5	MTH10526	Random vibration	4	60	0	0	6	O
6	MTH10527	Aerodynamics	4	60	0	0	6	O
7	MTH10611	Symbolic programming for applied problems	4	45	30	0	6.5	O
8	MTH10613	Fracture Mechanics	3	45	0	0	4.5	O
9	MTH10612	Introduction to mechanics	2	30	0	0	3	O

7.2.2.2. Specialization in Algebra

- a. Required courses by specialization: students select 4 courses from the list of specialization below to pass and accumulate in total of **16 credits at least**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10418	Homogeneous algebra	4	60	0	0	6	O
2	MTH10419	Commutative Algebra	4	60	0	0	6	O
3	MTH10420	Introduction to ring theory	4	60	0	0	6	O
4	MTH10421	Modern algebra	4	60	0	0	6	O
5	MTH10422	Field Theory and Galois	4	60	0	0	6	O
TOTAL			16				24	

- b. Optional courses: students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10492	Algebraic Topology	4	60	0	0	6	O

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
2	MTH10596	Group theory	4	60	0	0	6	O
3	MTH10497	The theory of finite group representation	4	60	0	0	6	O
4	MTH10498	Introduction to number theory	4	60	0	0	6	O
5	MTH10499	Finite field theory	4	60	0	0	6	O
6	MTH10500	Modules and applications	4	60	0	0	6	O
7	MTH10501	Seminar on Algebra	4	60	0	0	6	O
8	MTH10502	Graph theory	2	30	0	0	3	O
9	MTH10503	Computer Algebra	4	60	0	0	6	O
10	MTH10504	Algebraic Graph Theory	4	45	0	30	6.5	O
11	MTH10505	Fractional Algebra	4	60	0	0	6	O
12	MTH10506	Graph algebra	4	60	0	0	6	O
13	MTH10507	Introduction to combinatorics	4	45	0	30	6.5	O
14	MTH10601	A History of Thinking of Numbers and Algebra	3	30	0	30	5	O
15	MTH10602	Introduction to division ring theory	4	60	0	0	6	O
16	MTH10603	Introduction to group algebra	4	45	0	30	6.5	O

7.2.2.3. Specialization in Analysis

- a. Required courses by specialization: students select 4 courses from the list of specialization below to pass and accumulate in total of **16 credits at least**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10436	Real Analysis	4	60	0	0	6	O
2	MTH10410	Numerical Analysis 1	4	45	30	0	6.5	O
3	MTH10411	Qualitative Theory of Differential Equations	4	60	0	0	6	O
4	MTH10412	Complex Variable Functions	4	60	0	0	6	O
5	MTH10413	Equations of Mathematical Physics	4	60	0	0	6	O
6	MTH10414	Partial Differential Equations	4	60	0	0	6	O
7	MTH10415	Finite Element Analysis	4	45	30	0	6.5	O
8	MTH10417	Topology	4	60	0	0	6	O
TOTAL			16				24	

- b. Optional courses: students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10409	Nonlinear Analysis	4	60	0	0	6	O
2	MTH10451	Seminar on Analysis	4	60	0	0	6	O
3	MTH10460	Integral Transforms and applications	4	60	0	0	6	O
4	MTH10461	Ill-posed problems	4	60	0	0	6	O
5	MTH10462	Measure theory	4	60	0	0	6	O
6	MTH10465	Differential and Integral Equation	4	60	0	0	6	O
7	MTH10469	Branching in Differential Equations	4	60	0	0	6	O
8	MTH10470	Stability theory and applications	4	60	0	0	6	O
9	MTH10471	Multivalued differential equations	4	60	0	0	6	O
10	MTH10473	Stochastic Differential Equations	4	60	0	0	6	O
11	MTH10476	Harmonic Analysis	4	60	0	0	6	O
12	MTH10478	Differential topology	4	60	0	0	6	O
13	MTH10480	Differential Geometry	4	60	0	0	6	O
14	MTH10489	Numerical Analysis for inverse problems	4	45	30	0	6.5	O
15	MTH10490	Nonlinear operators	4	60	0	0	6	O
16	MTH10491	Calculus of Variation	4	60	0	0	6	O
17	MTH10492	Algebraic Topology	4	60	0	0	6	O
18	MTH10494	Multivariable complex function theory	4	60	0	0	6	O

7.2.2.4. The Specialization in Numerical Analysis

- a. Required courses by specialization: students select 4 courses from the list of specialization below to pass and accumulate in total of **16 credits at least**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10410	Numerical Analysis 1	4	45	30	0	6.5	O
2	MTH10414	Partial Differential Equations	4	60	0	0	6	O
3	MTH10415	Finite Element Analysis	4	45	30	0	6.5	O
4	MTH10436	Real Analysis	4	60	0	0	6	O
5	MTH10439	Numerical methods in linear algebra	4	45	30	0	6.5	O
6	MTH10444	System of Hyperbolic Partial Differential Equations of Conservation Law	4	45	30	0	6.5	O

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
7	MTH10445	An introduction to finite volume methods and its applications	4	45	30	0	6.5	O
8	MTH10610	Finite differential Analysis	4	45	30	0	6.5	O
9	MTH10604	Numerical methods in optimization	4	45	30	0	6.5	O
TOTAL			16				25	

- b. Optional courses: students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE CODE	COURSE NAME	No of credits	NUMBER OF LECTURES			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10438	Topics on Numerical Analysis	4	60	0	0	6	O
2	MTH10440	Advanced numerical methods in linear algebra	4	45	30	0	6.5	O
3	MTH10532	Seminar on Numerical Analysis	4	60	0	0	6	O
4	MTH10533	Numerical Analysis 2	4	60	0	0	6	O
5	MTH10535	Domain decomposition methods	4	60	0	0	6	O
6	MTH10537	Computational simulation for Partial Differential Equations with Julia	2	0	0	60	4	O
7	MTH10552	Finite Volume Methods for Partial Differential Equations of fluid dynamics	4	45	0	30	6.5	O

7.2.2.5. Specialization in Optimization

- a. Required courses by specialization: students select 4 courses from the list of specialization below to pass and accumulate a total of **15 credits at least**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10446	Operations Research	4	60	0	0	6	O
2	MTH10447	Nonlinear programming	4	60	0	0	6	O
3	MTH10615	Optimization models in Economics	3	30	30	0	5	O
4	MTH10449	Linear programming	4	45	30	0	6.5	O
5	MTH10450	Numerical Method in Optimization	4	45	0	30	6.5	O

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
6	MTH10543	Introduction to convex analysis and convex programming	4	60	0	0	6	O
TOTAL			15				23	

b. Optional courses: students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10616	Seminar on Optimization	4	60	0	0	6	O
2	MTH10553	Multi-objective optimization	4	60	0	0	6	O
3	MTH10538	Applied Optimization	4	60	0	0	6	O
4	MTH10539	Advanced Linear Programming	4	60	0	0	6	O
5	MTH10540	Nonsmooth Optimization: theory and numerical methods	4	60	0	0	6	O
6	MTH10541	Game Theory	4	60	0	0	6	O
7	MTH10544	Optimality conditions in nonsmooth Optimization	4	60	0	0	6	O
8	MTH10545	Optimal control	4	60	0	0	6	O
9	MTH10614	Variational methods in Optimum	4	60	0	0	6	O

7.2.2.6. Specialization in Probability and Statistics

a. Required courses by specialization: Students select 4 courses from the list of specialization below to pass and accumulate in total of **16 credits**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10423	Advanced Probability	4	60	0	0	6	R
2	MTH10424	Advanced Mathematical Statistics	4	60	0	0	6	R
3	MTH10619	Multivariate Statistics	4	45	30	0	6.5	R
4	MTH10426	Random process	4	60	0	0	6	R
TOTAL			16				24.5	

b. Optional courses: students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10508	Seminar on Probability and Statistics	4	60	0	0	6	O
2	MTH10509	Stochastic models in science and life	3	45	0	0	4.5	O
3	MTH10510	Statistics in Biology	3	30	30	0	5	O
4	MTH10511	Linear Models in Statistics	4	45	30	0	6.5	O
5	MTH10512	Economic Statistics	3	30	30	0	5	O
6	MTH10513	Analysis of Statistical Data	3	30	30	0	5	O
7	MTH10514	Bayesian Statistics	4	60	0	0	6	O
8	MTH10515	Non-parametric Statistics	4	60	0	0	6	O
9	MTH10516	Basic probability theory	4	60	0	0	6	O
10	MTH10517	Sampling Theory and Methods	4	45	30	0	6.5	O
11	MTH10485	Time Series	4	60	0	0	6	O
12	MTH10518	Functional Analysis in Statistics	4	60	0	0	6	O
13	MTH10609	Non-parametric Tests	4	45	30	0	6.5	O

7.2.2.7. Specialization in Data Science

- a. Required courses by specialization: students select 6 courses from the list of specialization below to pass and accumulate in total of **23 credits**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10312	Introduction to Database systems	4	45	30	0	6.5	R
2	MTH10318	Introduction to artificial intelligence	4	45	30	0	6.5	R
3	MTH10353	Introduction to machine learning	4	45	30	0	6.5	R
4	MTH10513	Analysis of Statistical Data	3	30	30	0	5	R
5	MTH10358	Data Mining	4	45	30	0	6.5	R
6	MTH10605	Python for Data Science	4	45	30	0	6.5	R
TOTAL			23				37.5	

- b. Optional courses: students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE NAME	Number of periods
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	COURSE CODE		No of credits	Theory	Practice	Exercise	No of ECTS	Course Type
1	MTH1032 2	Pattern recognition	4	45	0	30	6.5	O
2	MTH1032 3	Multi-dimensional signal processing	4	45	30	0	6.5	O
3	MTH1032 5	Algorithm analysis	4	45	30	0	6.5	O
4	MTH1034 4	SQL server Database Management system	4	45	30	0	6.5	O
5	MTH1035 2	Parallel computing	4	45	30	0	6.5	O
6	MTH1035 4	Advanced Machine Learning	4	45	30	0	6.5	O
7	MTH1061 9	Multivariate Statistics	4	45	30	0	6.5	O
8	MTH1045 0	Numerical Method in Optimization	4	45	0	30	6.5	O
9	MTH1048 5	Time series	4	60	0	0	6	O
10	MTH1051 6	Basic probability theory	4	60	0	0	6	O
11	MTH1060 6	Big data processing	4	45	30	0	6.5	O
12	MTH1062 0	Seminar on Data Science	4	60	0	0	6	O
13	MTH1060 8	Data visualization	4	45	30	0	6.5	O
14	MTH1060 7	Numerical Methods for Data Science	4	45	30	0	6.5	O

7.2.2.8. Specialization in Mathematical Methods in Computer Science

- a. Required courses by specialization: Students select 4 courses from the list of specialization below to pass and accumulate in total of **16 credits**.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH1031 7	Digital image analysis and processing	4	45	30	0	6.5	O
2	MTH1031 8	Introduction to Artificial Intelligence	4	45	30	0	6.5	O
3	MTH1031 9	Introduction to Cryptography	4	45	30	0	6.5	O
4	MTH1032 0	Digital signal processing	4	45	30	0	6.5	O
5	MTH1032 1	High Performance Computing	4	45	30	0	6.5	O
6	MTH1032 2	Pattern recognition	4	45	30	0	6.5	O
8	MTH1032 4	Arithmetic and Algorithms	4	45	30	0	6.5	O
9	MTH1032 5	Algorithm analysis	4	45	30	0	6.5	O
TOTAL			16				26	

- b. Optional courses: Students select these optional courses according to the provisions mentioned in Section 7.2.2. Remind that the credits in total required for graduation must be guaranteed.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10346	Seminar on Mathematical Methods in Computer Science	4	60	0	0	6	O
2	MTH10347	Information theory	4	45	30	0	6.5	O
3	MTH10348	Computer vision	4	45	30	0	6.5	O
4	MTH10349	Computational Geometry	4	45	30	0	6.5	O
5	MTH10350	Geometric design	4	60	0	0	6	O
6	MTH10351	Automata and formal languages	4	60	0	0	6	O
7	MTH10352	Parallel computing	4	45	30	0	6.5	O
8	MTH10353	Introduction to Machine Learning	4	45	30	0	6.5	O
9	MTH10354	Advanced Machine Learning	4	45	30	0	6.5	O
10	MTH10355	Mobile computing	4	45	0	30	6.5	O
11	MTH10356	Advanced Artificial Intelligence	4	45	0	30	6.5	O

7.2.2.9. Specialization in Applied Mathematical Computer Science

- a. **Compulsory/elective courses by major:** students choose 4 modules from the list of majors to achieve a total of at least 15 credits as follows.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10308	Object-oriented software development	4	45	30	0	6.5	O
2	MTH10309	System and Network Administration	4	30	60	0	7	O
3	MTH10310	Net Programming	4	45	30	0	6.5	O
4	MTH10311	Computer networking	4	45	30	0	6.5	O
5	MTH10312	Introduction to Database systems	4	45	30	0	6.5	O
6	MTH10313	Unix operating system	4	45	30	0	6.5	O
7	MTH10314	Software project management	4	45	30	0	6.5	O
8	MTH10315	Information Systems Analysis And Design	4	45	30	0	6.5	O
9	MTH10316	Java programming	3	30	30	0	5	O
TOTAL			15					

- b. Elective courses: Students choose according to the provisions of Section 7.2.2. Some additional modules suggest additional credits to be selected for graduation.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10326	Seminar Applied Mathematical Computer Science	4	60	0	0	6	O
2	MTH10327	Computer graphics	4	45	30	0	6.5	O
3	MTH10328	Algebraic curves and faces	4	60	0	0	6	O
4	MTH10329	Formal calculation programming	4	45	30	0	6.5	O
5	MTH10330	Network database	4	60	0	0	6	O
6	MTH10331	Rendering and image processing	4	45	30	0	6.5	O
7	MTH10332	Software Testing	3	30	30	0	5	O
8	MTH10333	Web design	3	30	30	0	5	O
9	MTH10334	Web Programming with J2EE	4	45	30	0	6.5	O
10	MTH10335	Network design	4	30	60	0	7	O
11	MTH10336	Software Testing 2	3	30	30	0	5	O
12	MTH10337	Web Programming with PHP	4	30	60	0	7	O
13	MTH10338	J2EE Topics	3	30	30	0	5	O
14	MTH10339	Network security	4	45	30	0	6.5	O
15	MTH10340	Pattern recognition and analysis	4	45	30	0	6.5	O
16	MTH10341	NET topics	4	45	30	0	6.5	O
17	MTH10342	Wireless Lan security	4	45	30	0	6.5	O
18	MTH10343	Design and build web with PHP	4	45	30	0	6.5	O
19	MTH10344	SQL Server Database Management system	4	45	30	0	6.5	O
20	MTH10345	Web programming with ASP.NET	4	45	30	0	6.5	O
21	MTH10357	Network topic	3	30	30	0	5	O

7.2.2.10. Specialization in Theory and Methods of Teaching Mathematics

- a. Compulsory/elective courses by major: Students take 6 courses from the list to achieve a total of 20 credits as follows.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10101	Pedagogy Psychology	4	30	60	0	7	R
2	MTH10102	Best practices in teaching	3	30	30	0	5	R
3	MTH10104	Education Study	3	30	0	30	5	R
4	MTH10105	Didactics of teaching	3	30	30	0	5	R
5	MTH10106	Elementary Number Theory And Mathematical Logic	3	30	30	0	5	R
6	MTH10112	Pedagogical Mathematics Practice	4	0	120	0	8	R
TOTAL			20					

- b. Elective courses: Students choose according to the provisions of Section 7.2.2. Some additional modules suggest additional credits to be selected.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10103	Quality and quality management	3	30	30	0	5	O
2	MTH10119	Mathematics in English 1	2	30	0	0	3	O
3	MTH10120	Mathematics in English 2	2	30	0	0	3	O
4	MTH10121	Elementary Algebra	4	60	0	0	6	O
5	MTH10122	Elementary Geometry	4	60	0	0	6	O
6	MTH10123	Application of advanced mathematical methods in solving complex high school's mathematics problem	4	60	0	0	6	O
7	MTH10124	Classroom Management And Organization	4	30	60	0	7	O
8	MTH10125	Classroom assessment techniques	3	30	30	0	5	O
9	MTH10126	Pedagogy Seminar	4	60	0	0	6	O

7.2.2. 11. Specialization in Financial Mathematics

- a. Compulsory/elective courses by major: Students take 5 courses in the list to achieve a total of 20 credits as follows: (from 16 to 20 credits)

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10201	Elementary Financial Mathematics	4	45	0	30	6.5	R
2	MTH10202	Forecasting	4	30	30	30	7	R
3	MTH10203	Mathematical finance models	4	45	0	30	6.5	R
4	MTH10204	Financial and monetary theory	4	45	0	30	6.5	R
5	MTH10209	Advanced Financial Mathematics	4	45	30	0	6.5	R
TOTAL			20					

- b. Elective courses: Students choose according to the provisions of Section 7.2.2. Some additional modules suggest additional credits to be selected.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10214	Quantative Microeconomics	4	45	0	30	6.5	O
2	MTH10215	Quantative Macroeconomics	4	45	0	30	6.5	O
3	MTH10216	Risk management	4	45	0	30	6.5	O
4	MTH10217	Corporate finance	4	45	0	30	6.5	O
5	MTH10218	Seminar on Mathematical finance	4	60	0	0	6	O
6	MTH10219	Financial analysis	4	45	0	30	6.5	O
7	MTH10220	Actuarial Mathematics	4	45	0	30	6.5	O

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
8	MTH10221	Advanced Actuarial Mathematics	4	45	0	30	6.5	O

7.2.3. Non-specialized elective courses

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10549	Internship	4	60	0	0	6	O
2	MTH10617	Surveys of Mathematics, Computer Science, and specializations	2	30	0	0	3	O

7.2.4. Graduation knowledge: 10 credits , students choose 1 of 2 options

a. Option 1: students do their graduation thesis of 10 credits.

No	COURSE CODE	COURSE NAME	No of credits	Number of periods			No of ECTS	Course Type
				Theory	Practice	Exercise		
1	MTH10595	Undergraduate Thesis	10	0	300	0	20	

b. Option 2: students accumulate 10 credits of free electives according to the provisions of Section 7.2.2.

8. TEACHING PLAN

The general courses students are required to study according to the set schedule. The specialized courses have suggested progress for students to choose to study.

8.1.1. Mathematics – Informatics – Natural Sciences

No	COURSE CODE	COURSE NAME	Plan (semester)
1	MTH00010	Analysis 1A	1
2	MTH00011	Differential and Integral Calculus, Calculus 1A	1
3	MTH00012	Analysis 2A	3
4	MTH00013	Differential and Integral Calculus, Calculus 2A	2
5	MTH00014	Analysis 3A	3
6	MTH00015	Analysis 4A	4
7	MTH00030	Linear algebra	1
8	MTH00031	Higher Algebra	2
9	MTH00055	Basic Computer Programming	2
10	MTH00083	Linear Algebra Practice	1
11	MTH00084	Higher Algebra Practice	2
12	MTH00087	Computational Softwares	3

8.1.2. Basic knowledge of the industry (Generally required in the direction)

No	COURSE CODE	COURSE NAME	Plan (semester)
a. Mathematics concentration (Mechanics, Algebra, Analysis, Numerical Analysis, Optimization, Statistical Probability)			
Students study 05 modules (19 credits):			
1	MTH10401	Measure Theory and Probability	3, 5
2	MTH10402	Algebra A2	3, 5,7
3	MTH10403	Functional Analysis	4, 6, 8
4	MTH10404	Mathematical Statistics	4, 6, 8
5	Choose 01 out of 03 courses		
	MTH10405	Data Structures and Algorithms	3, 5, 7
	MTH10406	Discrete Mathematics	4, 6, 8
	MTH10407	Object Oriented Programming	4, 6, 8
b. Computer science concentration (Applied Mathematical Computer Science, Mathematical Methods in Informatics, Data Science)			
Students study 05 modules (19 credits):			
1	MTH10404	Mathematical Statistics	4, 6, 8
2	MTH10405	Data Structures and Algorithms	3, 5
3	MTH10406	Discrete Mathematics	4, 6
4	MTH10407	Object Oriented Programming	4, 6
5	Choose 01 out of 03 courses		
	MTH10401	Measure Theory and Probability	3, 5, 7
	MTH10402	Algebra A2	3, 5, 7
	MTH10403	Functional Analysis	4, 6, 8
c. Mathematics Education concentration (Theory and methods of teaching mathematics)			
Students study 05 modules to achieve 18TC:			
1	MTH10110	Methods of Teaching Mathematics 1	4, 5
2	MTH10111	Methods of Teaching Mathematics 2	4, 5
3	MTH10401	Measure Theory and Probability	3, 5, 7
4	MTH10402	Algebra A2	3, 5, 7
5	MTH10403	Functional Analysis	4, 6, 8
d. Quantitative Finance concentration (Financial Mathematics)			
Students study 04 modules (15 credits):			
1	MTH10401	Measure Theory and Probability	3, 5
2	MTH10402	Algebra A2	3, 5, 7
3	MTH10403	Functional Analysis	4, 6, 8

4	MTH10404	Mathematical Statistics	4, 6
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8.1.3. Specialized knowledge:

Specialization in Mechanics

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10410	Elementary numerical Analysis	4, 6, 8
2	MTH10413	Equations Mathematical Physics	4, 6, 8
3	MTH10427	Theoretical mechanics	5
4	MTH10428	Continuum mechanics	5
5	MTH10429	Finite element method	7
6	MTH10412	Complex Variable Functions	4, 6, 8
7	MTH10434	Solid mechanics	6
8	MTH10435	Fluid mechanics	6

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10430	Vibration and Stability Theory	5
2	MTH10520	Seminar on mechanics	6, 7, 8
3	MTH10521	Finite difference methods	6
4	MTH10524	Dynamics of Multibody Systems and Robotics	8
5	MTH10526	Random vibration	5
6	MTH10527	Aerodynamics	8
7	MTH10611	Symbolic programming for applied problems	6
8	MTH10613	Mechanics of Destruction	6
9	MTH10612	Introduction to mechanics	4

Specialization in Algebra

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10418	Homogeneous algebra	6
2	MTH10419	Commutative Algebra	5
3	MTH10420	Introduction to ring theory	5
4	MTH10421	Modern algebra	4
5	MTH10422	Field Theory and Galois	6

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10596	Group theory	8
2	MTH10497	The theory of finite group representation	7
3	MTH10498	Introduction to number theory	7
4	MTH10499	Finite field theory	8
5	MTH10500	Modules and applications	7
6	MTH10501	Algebra Seminar	7
7	MTH10502	Graph theory	7
8	MTH10503	Computer Algebra	6
9	MTH10504	Algebraic Graph Theory	8
10	MTH10505	Fractional Algebra	6
11	MTH10506	Graph algebra	7
12	MTH10507	Introduction to combinatorics	6
13	MTH10492	Algebraic Topology	8
14	MTH10601	A History of Thinking of Numbers and Algebra	4
15	MTH10602	Introduction to division ring theory	7
16	MTH10603	Introduction to group algebra	7

Specialization in Analysis

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10436	Real Analysis	4, 6, 8
2	MTH10410	Elementary numerical Analysis	4, 6, 8
3	MTH10411	Qualitative Theory of Differential Equations	5, 7
4	MTH10412	Complex Variable Functions	4, 6, 8
5	MTH10413	Equations Mathematical Physics	5, 7
6	MTH10414	Partial differential equations	6, 8
7	MTH10415	Finite Element Analysis	6, 8
8	MTH10417	Topology	5, 7

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10409	Nonlinear Analysis	5, 7
2	MTH10451	Seminar on Analysis	6, 7, 8
3	MTH10460	Integral Transforms and applications	6, 7, 8
4	MTH10461	Ill-posed problems	5, 7
5	MTH10462	Measure theory	3, 5, 7
6	MTH10465	Differential and Integral Equation	5, 7
7	MTH10469	Branching in differential equations	6, 7, 8
8	MTH10470	Stability theory and applications	6, 7, 8
9	MTH10471	Multivalued differential equation	6, 7, 8
10	MTH10473	Stochastic Differential Equations	6, 7, 8
11	MTH10476	Harmonic Analysis	6, 7, 8
12	MTH10478	Differential topology	6, 8
13	MTH10480	Differential Geometry	5, 7
14	MTH10489	Numerical Analysis for inverse problems	6, 8
15	MTH10490	Nonlinear operators	6, 8
16	MTH10491	Calculus of Variation	5, 7
17	MTH10492	Algebraic Topology	6, 8
18	MTH10494	Multivariable complex function theory	5, 7

Specialization in Numerical Analysis

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10410	Elementary numerical Analysis	6, 8
2	MTH10414	Partial differential equations	6, 8
3	MTH10415	Finite Element Analysis	6, 8
4	MTH10436	Real Analysis	4, 6, 8
5	MTH10439	Numerical methods in linear algebra	5, 7
6	MTH10444	Hyperbolic system of conservation laws	6, 8
7	MTH10445	Introduction to finite volume methods and their applications	6, 8
8	MTH10610	Finite differential Analysis	5, 7
9	MTH10604	Numerical method in optimization	6, 8

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10438	Topic in numerical analysis	
2	MTH10440	Numerical methods in advanced linear algebra	
3	MTH10532	Seminar on numerical analysis	6, 7, 8
4	MTH10533	Numerical analysis 2	5, 7
5	MTH10535	Computational domain discretization in numerical analysis	
6	MTH10537	Computational simulation for partial differential equation problems with Julia	
7	MTH10552	Finite volume method for partial differential equations of fluid motion	

Specialization in Optimization

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10446	Operations Research	5, 7
2	MTH10447	Nonlinear Programming	4, 6, 8
3	MTH10615	Optimal model in economics	5, 7
4	MTH10449	Linear programming	4, 6, 8
5	MTH10450	Numerical Method in Optimization	4, 6, 8
6	MTH10543	Introduction to Convex Analysis and Convex Programming	5, 7

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10616	Optimal Seminar	4 to 8
2	MTH10553	Multi-objective optimization	5, 7
3	MTH10538	Applied Optimization	4, 6, 8
4	MTH10539	Advanced Linear Programming	5, 7
5	MTH10540	Nonsmooth optimization: theory and numerical methods	4, 6, 8
6	MTH10541	Game theory	4, 6, 8
7	MTH10544	Optimality conditions in nonsmooth optimization	5, 7
8	MTH10545	Optimal control	5, 7
9	MTH10614	Variational methods in Optimization	4, 6, 8

Specialization in Probability – Statistics

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10423	Advanced Probability	5, 7
2	MTH10424	Advanced Mathematical Statistics	5, 7
3	MTH10619	Multivariate Statistics	6, 8
4	MTH10426	Stochastic process	6, 8

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10485	Time series	5,7
2	MTH10508	Seminar on Probability and Statistics	7
3	MTH10509	Stochastic models in Science and Life	5, 7
4	MTH10510	Statistics in Biology	5, 7
5	MTH10511	Linear Models in Statistics	5, 7
6	MTH10512	Economy Statistics	5, 7
7	MTH10513	Statistical Data Processing	5, 7
8	MTH10514	Bayesian Statistics	6, 8
9	MTH10515	Non-parametric Statistics	6, 8
10	MTH10516	Basic probability theory	4
11	MTH10517	Sampling Theory and Methods	5, 7
12	MTH10518	Functional analysis in Statistics	5, 7
13	MTH10609	Non-parametric test	

Specialization in Data Science

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)v
1	MTH10312	Introduction to Database systems	4
2	MTH10318	Introduction to artificial intelligence	5
3	MTH10353	Introduction to machine learning	6
4	MTH10513	Statistical processing	5
5	MTH10358	Data Mining	6
6	MTH10605	Python for data science	5,7

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10322	Pattern recognition	7
2	MTH10323	Multidimensional signal processing	6
3	MTH10325	Algorithm analysis	6
4	MTH10344	SQL Server Database Management system	6
5	MTH10352	Parallel computing	6
6	MTH10354	Advanced machine learning	7
7	MTH10619	Multivariate Statistics	6, 8
8	MTH10450	Numerical Method in Optimization	4, 6, 8
9	MTH10485	Time series	7
10	MTH10516	Basic probability theory	4
11	MTH10606	Big data processing	7
12	MTH10608	Data visualization	7
13	MTH10607	Numerical Methods for Data Science	7
14	MTH10620	Seminar on Data Science	7

Specialization in Mathematical Methods in Informatics

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10317	Digital image analysis and processing	5
2	MTH10318	Introduction to artificial intelligence	5
3	MTH10319	Introduction to Cryptography	7
4	MTH10320	Digital signal processing	5
5	MTH10321	High Performance Computing	
6	MTH10322	Pattern recognition	7
7	MTH10323	Multidimensional signal processing	6
8	MTH10324	Arithmetic and Algorithms	6
9	MTH10325	Algorithm analysis	6

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10346	Seminar on Mathematical Methods in Computer Science	7
2	MTH10347	Information theory	6
3	MTH10348	Computer vision	7
4	MTH10349	Computational Geometry	6

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10346	Seminar on Mathematical Methods in Computer Science	7
5	MTH10350	Geometric design	7
6	MTH10351	Automats and formal languages	
7	MTH10352	Parallel computing	6
8	MTH10353	Introduction to machine learning	6
9	MTH10354	Advanced machine learning	7
10	MTH10355	Mobile computing	
11	MTH10356	Advanced Artificial Intelligence	

Specialization in Applied Mathematics

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10308	Object-oriented software development	5
2	MTH10309	Network Administration	6
3	MTH10310	Programming .Net	5
4	MTH10311	Internet	4
5	MTH10312	Introduction to Database systems	5
6	MTH10313	Unix operating system	5
7	MTH10314	Software project management	6
8	MTH10315	Information Systems Analysis And Design	6
9	MTH10316	Java programming	5

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10326	Seminar Applied Mathematical Computer Science	7
2	MTH10327	Computer graphics	6 to 8
3	MTH10328	Algebraic curves and faces	6 to 8
4	MTH10329	Formal calculation programming	6 to 8
5	MTH10330	Network database	6 to 8
6	MTH10331	Rendering and image processing	6 to 8
7	MTH10332	Software Testing	6
8	MTH10333	Web design	5
9	MTH10334	Web Programming with J2EE	6
10	MTH10335	Network design	5
11	MTH10336	Software Testing 2	7
12	MTH10337	Web Programming with PHP	6
13	MTH10338	J2EE Topics	7
14	MTH10339	Network security	7

No	COURSE CODE	COURSE NAME	Plan (Semester)
15	MTH10340	Pattern recognition and analysis	6 to 8
16	MTH10341	NET topics	7
17	MTH10342	Wireless Lan security	6 to 8
18	MTH10343	Design and build web with PHP	6 to 8
19	MTH10344	SQL Server Database Management system	6
20	MTH10345	Web programming with ASP.NET	6
21	MTH10357	Network topic	6

Specialization in Theory and Teaching Methods of Mathematics

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10101	Pedagogy Psychology	4 to 8
2	MTH10102	Best practices in teaching	4 to 8
3	MTH10104	Education Study	4, 5
4	MTH10105	Didactics of teaching	4, 5
5	MTH10106	Elementary Number Theory And Mathematical Logic	4, 6
6	MTH10112	Pedagogical Mathematics Practice	8

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10103	Quality and quality management	4, 6
2	MTH10119	Mathematics in English 1	4, 6
3	MTH10120	Mathematics in English 2	5, 7
4	MTH10121	Elementary Algebra	4, 6
5	MTH10122	Elementary Geometry	5, 7
6	MTH10123	Application of advanced mathematical methods in solving complex high school's mathematics problem	5, 7
7	MTH10124	Classroom Management And Organization	5 to 8
8	MTH10125	Classroom assessment techniques	5 to 8
9	MTH10126	Pedagogy Seminar	6

Specialization in Financial Mathematics

Separate compulsory courses:

No	COURSE CODE	COURSE NAME	Plan (Semester)
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1	MTH10201	Elementary Financial Mathematics	5 to 8
2	MTH10202	Forecasting	5 to 8
3	MTH10203	Mathematical finance models	5 to 8
4	MTH10204	Financial and monetary theory	5 to 8
5	MTH10209	Advanced Financial Mathematics	5 to 8

Elective course:

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10214	Quantative Microeconomics	5 to 8
2	MTH10215	Quantative Macroeconomics	5 to 8
3	MTH10216	Risk management	6 to 8
4	MTH10217	Corporate finance	5 to 8
5	MTH10218	Seminar on Mathematical finance	5 to 8
6	MTH10219	Financial analysis	5 to 8
7	MTH10220	Actuarial Mathematics	5 to 8
8	MTH10221	Advanced Actuarial Mathematics	6 to 8

Non-specialized elective courses

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10549	Internship	6, 7, 8
2	MTH10617	Surveys of Mathematics, Computer Science, and specializations	4

Graduation knowledge: 10 credits

No	COURSE CODE	COURSE NAME	Plan (Semester)
1	MTH10595	Undergraduate Thesis	7, 8

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