

UK 066/404

CURRICULUM FOR THE
MASTER'S PROGRAM IN
**COMPUTER
MATHEMATICS.**



JOHANNES KEPLER
UNIVERSITY LINZ

Contents

§ 1 Qualification Profile	3
§ 2 Admissions	4
§ 3 Structure and Outline	4
§ 4 Mandatory Subjects/Modules	5
§ 5 Elective Subjects/Modules	5
§ 6 Courses	6
§ 7 Replacement of Subjects and Courses	6
§ 8 Master's Thesis	6
§ 9 Examination Regulations	6
§ 10 Academic Degree	7
§ 11 Legal Validity	7
§ 12 Transitional Provisions	7

§ 1 Qualification Profile

The bachelor's program Technical Mathematics and the master's programs in Mathematics in Natural Sciences, Industrial Mathematics, and Computer Mathematics at the Johannes Kepler University (JKU) share the common general goal of preparing their students for the following activities:

- The design and analysis of mathematical models for processes appearing in technology, economy, and natural sciences,
- The application of known and the development of new problem solving methods for such models according to the current state of the mathematical sciences,
- The application and use of computational methods, typically by implementing algorithms on computers according to the current state of software sciences.

All graduates of our programs are therefore prepared to contribute to a variety of different areas, including, but not limited to:

- Research and development institutions in industry, economy, or the public sector
- Companies offering financial services, such as banks or insurance companies,
- Companies in the areas of software development and information technology,
- Universities, or other institutions of higher education, or other scientific institutions.

The master's program Computer Mathematics offers a special training in methods and techniques that are at the interface between mathematics and computer science. It is divided into three main subjects:

- Algebra, number theory, and discrete mathematics
- Logic, formal methods, and theoretical computer science
- Practical computer science and software development

Students will not only learn how to use existing computer algebra software or automated theorem provers. Instead, they will get acquainted with all steps of the development process that underlies such software systems: the exploration of the relevant theoretical background, the design and analysis of algorithms, the implementation of algorithms into software, the testing and evaluation of implementations, and the application of mathematical software to problems arising in other areas of mathematics or computer science, in natural sciences, in engineering, and also in social or economic contexts.

Students will acquire highly specialized knowledge touching the edge of current research in computer mathematics. They will develop a critical awareness of the opportunities and limitations of relevant theory and its applications, which will serve them as a basis for independently finding innovative solutions, integrating new external expertise and techniques from other areas. They will be prepared to take responsible leading positions, in particular, when complex and unpredictable contexts require new and individualized solution approaches.

With the education received on all these matters, graduates of the master's program Computer Mathematics are excellently prepared for a broad variety of jobs in the public sector or in the private sector; jobs whose demands, for graduates of traditional mathematics curricula, would reach too far into computer science, and whose demands, for graduates of traditional computer science curricula, would reach too far into mathematics.

§ 2 Admissions

(1) In accordance with § 54 para. 1 UG the Master's program belongs to the category of engineering degrees and is taught in English.

(2) The Master's program Computer Mathematics is based on the Bachelor's program in Technical Mathematics (033 201) at JKU. Graduates of this Bachelor's program are admitted to the Master's program without any restrictions.

(3) Graduates of programs in Mathematics, Technical Mathematics, Mathematics Education, Computer Science, Engineering, Natural Sciences or related programs at Universities, Universities of Applied Sciences, or other recognized national or international post-secondary educational institutions can be admitted to the Master's program provided that their curriculum amounts to 180 ECTS and prepares them equally well for the Master's program Computer Mathematics as the Bachelor's program Technical Mathematics at JKU. Equivalent programs are those which include the following contents in the stated minimum scope.

- Linear Algebra (12 ECTS)
- Analysis (9 ECTS)
- Algebra and Discrete Mathematics (3 ECTS)
- Computational Logic (3 ECTS)
- Algorithmic Combinatorics (3 ECTS)
- Computer Algebra (3 ECTS)
- Algorithms and Data Structures (3 ECTS)
- Programming (6 ECTS)
- at least 12 ECTS for arbitrary courses that appear as mandatory or elective courses in the Bachelor's program Technical Mathematics at JKU.

(4) Graduates of programs that do not meet the requirements of para. 3 can be granted admission on condition to complete additional courses with up to 40 ECTS points during their Master's studies.

§ 3 Structure and Outline

(1) The Master's program in Computer mathematics covers 4 semesters and consists of 120 ECTS points, which are distributed among the following subjects:

Bezeichnung	ECTS
Mandatory Subjects	33
Elective Subjects	28.5
Master's Thesis (incl. Master's Thesis Seminars)	36
Master's Examination	10.5
Free Electives	12
Total	120

(3) For the Free Electives students have to pass courses corresponding to 12 ECTS points, which can be chosen from any recognized national or international post-secondary educational institution. The Free Electives shall provide additional skills beyond Computer Mathematics and can be taken anytime during the Master's study.

(4) The recommended course of study is shown in the annex 1.

§ 4 Mandatory Subjects/Modules

(1) The following mandatory subjects have to be completed successfully:

Code	Bezeichnung	ECTS
404ANDM20	Algebra, Number Theory, and Discrete Mathematics	12
404LFMT20	Logic, Formal Methods, and Theoretical Computer Science	12
404PCSD20	Practical Computer Science and Software Development	9

(2) If courses of the mandatory subjects have already been taken as courses during the Bachelor's studies on which the admission to the Master's studies was based, additional courses with the corresponding amount of ECTS have to be taken from the elective subjects.

§ 5 Elective Subjects/Modules

(1) Students have to select courses with a total of 28.5 ECTS from the following electives:

Code	Bezeichnung	ECTS
404ANAS12	a. Analysis	0-7,5
404NUAN20	b. Numerical analysis	0-3
404PTMS20	c. Probability theory and mathematical statistics	0-12
404MMNS20	d. Mathematical methods in the natural sciences	0-3
404MMEN20	e. Mathematical methods in engineering	0-3
404MMES20	f. Mathematical methods in the economic sciences	0-3
404OPTI20	g. Optimization	0-3
404SYCO20	h. Symbolic computation	0-22,5
404LOSD20	i. Logic and software design	0-28,5
404ADMA20	j. Algebra and discrete mathematics	0-25,5
404FUAN20	k. Functional analysis	0-3
404GEOM20	l. Geometry	0-27
404KBMS20	m. Knowledge-based Mathematical Systems	0-18
404NUTH20	n. Number theory	0-27
404SOSK20	o. Soft Skills	0-6

(2) Students must select only such courses from the Electives that have not been completed in the Bachelor's program on which the admission to the Master's studies was based.

§ 6 Courses

(1) The names and the types of all courses of the mandatory and elective subjects, as well as their ECTS points, their duration in hours per week, their codes, their registration requirements, and their admission procedures (in case of limited availability of places) are described in the study handbook of JKU (www.studienhandbuch.jku.at).

(2) The possible types of courses as well as the examination regulations are described in §§ 13 and 14 of the JKU statute (Section "Studienrecht").

§ 7 Replacement of Subjects and Courses

Mandatory subjects and elective subjects according to §§ 4 and 5 as well as courses according to § 6 para. 1 may be replaced to a total extent of 18 ECTS points by other study specific subjects and courses upon student's request, provided that the purpose of academic professional preparatory training is not affected and the choice of the proposed subjects and courses seems reasonable with regard to the defined aims in the qualification profile, the academic context as well as to the addition to the professional preparatory training. The application of replacing subjects and courses has to be filed by the Vice Rector of Academic Affairs.

§ 8 Master's Thesis

(1) Students of the Master's program in Computer Mathematics must complete a Master's thesis according to § 81 UG and § 36 of the JKU statute (Section "Studienrecht").

(2) The Master's thesis is a written scientific paper corresponding to an effort of 20 ECTS points.

(3) The Master's thesis serves as a proof that graduates are able to perform scientific work autonomously and systematically. The topic of the thesis must be taken from the mandatory or from one of the following elective subjects: h. Symbolic computation, i. Logic and software design, j. Algebra and discrete mathematics, l. Geometry, m. Knowledge based mathematical systems, or n. Number theory. It must permit completion within a period of 6 months.

(4) The Curricular Committee for Technical Mathematics may specify guidelines for the formal structure of a Master's thesis.

(5) In addition to the Master's thesis, students must pass two Master's thesis seminars with 8 ECTS points each.

§ 9 Examination Regulations

(1) The regulations for subject examinations and course examinations are described in the study handbook of JKU.

(2) The Master's program in Computer Mathematics is concluded by a Master's examination.

(3) The Master's examination consists of two parts: The first part is the successful completion of the mandatory and elective subjects according to §§ 4 and 5.

(4) The second part of the Master's examination is a comprehensive oral exam (10.5 ECTS points) conducted by an examination committee. Prior to being admitted to this second part of the Master's examination, students must complete the first part of the Master's examination, the Master's Thesis Seminars, the Master's thesis, and the Free Electives.

(5) The second part of the Master's examination starts with a presentation and defense of the Master's thesis, followed by an oral exam that covers the contents of the subject area from which the Master's thesis topic was chosen as well as an oral exam that covers the contents of one additional subject. The second examination area is proposed by the student and chosen by the Vice Rector of Academic Affairs.

(6) The oral exam shall focus on the general overview and the familiarity with thematic scientific contexts.

(7) The examination committee consists of three members and is formed by the Vice Rector of Academic Affairs. The candidate may submit a proposal for the committee members. In general, the advisor of the Master's thesis is a member of the examination committee. The head of the committee suggests the assessment of the presentation and of the defense of the thesis. The other two examiners suggest the assessment of the subject they have examined, respectively.

§ 10 Academic Degree

(1) Graduates of the Master's program in Computer Mathematics are awarded the academic degree „Diplom-Ingenieurin/Diplom-Ingenieur“, abbreviated „Dipl.-Ing.“ or „Dipl.-Ing. (JKU)“ or “DI” or “DI (JKU)”.

(2) The certificate about the academic degree is issued in German and in English translation.

§ 11 Legal Validity

(1) This Curriculum comes into effect on October 1, 2020.

(2) The curriculum of the Master's program in Computer Mathematics in the version published in the official newsletter of Johannes Kepler University Linz on June 22, 2018, 26th piece, item 279 expires by the end of September 30, 2020, unless otherwise specified below.

§ 12 Transitional Provisions

(1) For students who have passed examinations within the curriculum of the Master's program in Computer Mathematics in a previous version, the equivalences listed in the study handbook of JKU (studienhandbuch.jku.at) apply.

(2) In addition to the mentioned equivalences given in the study handbook of JKU, the following equivalence tables apply:

Subjects/package of subjects in the Master Computer Mathematik version of 2018	equivalent subjects/package of subjects in the Master Computer Mathematics version of 2020
---	---

404ALMA12: Algorithmische Mathematik (13,5 ECTS) + 404SWTE12: Softwaretechnologie (12 ECTS) + 404MALO12: Mathematische Logik (6 ECTS)	404ANDM20: Algebra, Number Theory, and Discrete Mathematics (12 ECTS) + 404PCSD20: Practical Computer Science and Software Development (9 ECTS) + 404LFMT20: Logic, Formal Methods, and Theoretical Computer Science (12 ECTS)
404WAF12: Wahlfächer (34,5 ECTS) + 404FRST12: Freie Studienleistungen (7,5 ECTS)	404ELEC20: Electives (28.5 ECTS) + 404FRST20: Free electives (12 ECTS)

lectures/package of lectures in the Master Computer Mathematik version of 2018	equivalent lectures/package of lectures in the Master Computer Mathematics version of 2020
TMCPAVOKOMM: VL Kommutative Algebra und Algebraische Geometrie (6 ECTS)	404ANDMCA2V20: VL Computer Algebra II (3 ECTS) + 404ANDMANTV20: VL Applied Number Theory (3 ECTS)
TMCPVVOLOG1: VO Mathematische Logik 1 (6 ECTS)	404LFMTML1V20: VL Mathematical logic 1 (3 ECTS) + 404LFMTAURV20: VL Automated Reasoning (3 ECTS)
TMCPAVOSIMU: VO Stochastische Simulation (3 ECTS)	404LFMTMVLV20: VL Manyvalued Logic (3 ECTS)
TMCPBKVMSE: KV Formale Methoden in der Software-Entwicklung (6 ECTS)	921SOENFMSK13: KV Formal methods in software development (4.5 ECTS) + <i>lecture from i. Logic and software design (1.5 ECTS)</i>
TMCPBKVSWTE: KV Praktische Softwaretechnologie (6 ECTS)	404PCSDPSTK20: KV Practical software technology (4.5 ECTS) + <i>lecture from i. Logic and software design (1.5 ECTS)</i>
<i>lecture from h. Symbolic computation (3 ECTS)</i> or <i>lecture from j. Algebra and discrete mathematics (3 ECTS)</i> with the exception of Spezialvorlesung (3 ECTS)	404ANDMCOAV20: VL Computer Analysis (3 ECTS)
<i>lecture from i. Logic and software design (3 ECTS)</i> with the exception of Spezialvorlesung (3 ECTS)	921CGELSASK19: KV SAT Solving (3 ECTS)
404WAFAMDSS12: SE Master- und Dissertantenseminar (3 ECTS)	<i>lecture from h. Symbolic computation (3 ECTS)</i> or <i>lecture from j. Algebra and discrete mathematics (3 ECTS)</i> or <i>lecture from l. Geometrie (3 ECTS)</i> or <i>lecture from m. Knowledge-based Mathematical Systems (3 ECTS)</i>

TM1WHVOELIM: VO Eliminationstheorie (3 ECTS)	<i>lecture from h. Symbolic computation (3 ECTS)</i>
TM1WIVOELTH: VO Entscheidbare logische Theorien (3 ECTS)	<i>lecture from h. Symbolic computation (3 ECTS)</i>
TM1WIVOKOMP: VO Entscheidbarkeits- und Komplexitätsklassen (3 ECTS)	<i>lecture from h. Symbolic computation (3 ECTS)</i>
TM1WIVOLOG2: VO Mathematische Logik 2 (3 ECTS)	<i>lecture from h. Symbolic computation (3 ECTS)</i>
TM1WJVOIKTH: VO Informations- und Kodierungstheorie (3 ECTS)	<i>lecture from j. Algebra and discrete mathematics (3 ECTS)</i>
TM1WJUEIKTH: UE Informations- und Kodierungstheorie (1,5 ECTS)	<i>lecture from j. Algebra and discrete mathematics (1.5 ECTS)</i>
TM1WLIVOSPLI: VO Splines (3 ECTS)	<i>lecture from l. Geometrie (3 ECTS)</i>
TM1WLUESPLI: UE Splines (1,5 ECTS)	<i>lecture from l. Geometrie (1.5 ECTS)</i>

(3) Students who have formally registered their Master's thesis before October 1, 2020 have the option to complete their Master's thesis until September 30, 2021 according to the regulations of the previous version of the curriculum (valid until September 30, 2020), i.e., without taking any Master's thesis seminars.

Global map of study subjects - Master's Program "Computer Mathematics"

1 st Semester (WS)		2 nd Semester (SS)		3 rd Semester (WS)		4 th Semester (SS)	
Subject/Course	ECTS	Subject/Course	ECTS	Subject/Course	ECTS	Subject/Course	ECTS
Algebra, Number Theory, and Discrete Mathematics Applied Number Theory Algebraic combinatorics	6	Algebra, Number Theory, and Discrete Mathematics Computer Analysis Computer Algebra II	6	Master's Thesis Seminars Master's Thesis Seminar I	8	Master's Thesis Seminars Master's Thesis Seminar II	8
Logic, Formal Methods, and Theoretical Computer Science Mathematical Logic 1 Automated Reasoning	6	Logic, Formal Methods, and Theoretical Computer Science Manyvalued Logic SAT Solving	6				
Practical Computer Science and Software Development Formal methods in software development	4,5	Practical Computer Science and Software Development Practical software technology	4,5	Master's Thesis	8,5	Master's Thesis	11,5
Electives	10,5	Electives	10,5	Electives	7,5	Final Exam	10,5
Free Electives	3	Free Electives	3	Free Electives	6		
30		30		30		30	