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## HEIDELBERG UNIVERSITY EXAMINATION AND DEGREE PROGRAMME RULES AND REGULATIONS FOR THE MASTER'S DEGREE PROGRAMME IN MATHEMATICS

of 11 March 2009

### *Preamble*

*All titles in this document, be they official, job, status or functions, are used in masculine form, however they refer to men and women equally and may also be used in the corresponding feminine form.*

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## I. General information

### § 1 Purpose of the academic programme and examination

- (1) The consecutive, research-oriented Master's degree programme in Mathematics conveys in-depth specialist knowledge and an understanding of the scientific methods employed in mathematics as well as, according to the interests of the student, in additional subject areas.
- (2) The purpose of the Master's examination is to assess whether students have an overview of the interconnections between the individual disciplines, are able to apply academic methods and knowledge, and have acquired the specialist knowledge required to enter into a profession or a doctorate programme.
- (3) Admission to the academic programme is subject to separate admissions regulations.

### § 2 Master's degree

Heidelberg University, represented by the Faculty of Mathematics and Computer Science, awards the academic degree of Master of Science" (abbreviated "M.Sc.") to candidates who have passed the Master's examination.

### § 3 Standard period of study, programme structure and range of courses offered

- (1) The standard period of study is four semesters, including the Master's examination.
- (2) Examination prerequisites are determined in terms of credits in accordance with the European Credit Transfer System. One credit corresponds to around 30 hours of work. Credits are awarded only for successfully completed modules. Successful completion of graded modules requires the grade "sufficient" (4.0) or higher.
- (3) The range of courses is aimed at allowing students to specialise in numerous branches of Mathematics and/or associated fields. It includes compulsory elective modules in pure mathematics, applied mathematics and in a mathematical specialisation area (16 credits each), as well as two mathematical seminars (6 credits each). In addition, there is an application area (18 credits) and the interdisciplinary skills courses (6 credits). As a general rule, the application area should be based on the application area chosen for the Bachelor's examination. The Master's thesis counts for 30 credits and is accompanied by a Master seminar (6 credits). Successful completion of the Master's degree programme requires successful

completion of the programme's lectures and courses (compulsory and elective) amounting to 120 credits (European Credit Transfer System).

- (4) Courses and examinations in the degree programme are mainly held in German, however, some are also held in English.
- (5) If the candidate does not fully complete the Master's examination within a period of three semesters after expiry of the standard period of study, he/she loses the entitlement to take the examination unless the student is not responsible for exceeding the deadline.

#### § 4 Examinations board

- (1) An examinations board is formed for organising examinations and tasks defined in these examination rules and regulations. It consists of three members of the full-time academic staff, of which two are professors and one is a representative of the research associates; one additional member must be a student with an advisory function.
- (2) The chairperson of the examinations board, the deputy chairperson as well as other members and their deputies are appointed by the faculty council. The chairperson and the deputy must be professors. The examinations board student member is appointed by the faculty council based on a proposal from the departmental student committee.
- (3) The members are appointed for three years; the student member is appointed for one year. Each term starts on September 1st. Members may be re-elected.
- (4) The examinations board ensures that the examination rules and regulations are respected. The board reports to the faculty regarding changes to examinations, study periods and grading on a regular basis.
- (5) The chairperson manages the business of the examinations board, prepares and chairs meetings and, in the event of a tie vote, has the deciding vote. The examinations board can confer further responsibility to its chairperson. Such a decision may be revoked at any time.
- (6) Examinations board members have the right to attend examinations.
- (7) Members of the examinations board and their deputies are subject to official secrecy. Those who are not civil servants are sworn to secrecy by the chairperson.

#### § 5 Examiners and observers

- (1) Following consultation with the examinations board, the chairperson appoints the examiners and observers for all examinations. Examiners must be lecturers in the Master's degree programme in Mathematics.
- (2) In general, examinations which are not completed during the course of study may only be administered by professors, associate professors, or research associates who have been granted the right to examine by the President's Office due to longstanding teaching experience.
- (3) Observers must have passed the Master's examination or at least an equivalent final examination.
- (4) In general, the lecturer for the respective lecture or course is responsible for determining the examination components to be completed for the given lecture or course during the course of study.
- (5) According to Section 2, all Master's thesis examiners and reviewers must be full-time employees at Heidelberg University's Faculty of Mathematics and Computer Science. According to Section 1, examiners to whom Sentence 1 does not apply, can only be appointed as examiners and reviewers if the second examiner or reviewer was appointed in accordance with Sentence 1. For examiners and observers, § 4 Section 7 (official secrecy) shall apply accordingly.

## **§ 6 Recognition of course credits, examination results and academic degrees**

- (1) Examination prerequisites and results, as well as academic degrees obtained in degree programmes at German universities or universities of cooperative education (state or state-recognised), or at foreign universities (state or state-recognised), will be recognised as long as there is no significant difference concerning the skills acquired, courses taken and degree obtained in the programme. This recognition is required in order to continue an academic programme, take examinations, enroll in a further academic programme or be admitted to a doctoral programme. The validity of § 15, Sections 3 and 4 LBG (State Public Service Law) remains unaffected.
- (2) Preliminary and intermediate examinations taken at other German universities in the same degree programme or in a similar degree programme will be recognised. Courses completed at recognised distance-learning institutions will be considered equivalent to those in a corresponding traditional degree programme with regard to determining the duration of study.
- (3) It is the applicant's responsibility to provide all information necessary for achievements to be recognised. It is the responsibility of the office which carries out the recognition procedure to prove that an application does not fulfil the requirements.

- (4) If agreements exist between the Federal Republic of Germany and other states concerning equivalent university degree programmes (Equivalency Agreements) that favour students from other states by way of derogation from paragraph 1 and § 29, paragraph 2, sentence 5 of the LHG (Act on Higher Education of the State of Baden-Württemberg), the rules and regulations in the Equivalency Agreement take precedence.
- (5) Examination results are to be graded on the basis of a credit point system that allows for achievements in equivalent or similar degree programmes to be recognised; this also applies to universities of cooperative education, provided that there is equivalence.
- (6) Knowledge and skills gained outside a university degree programme may be recognised for such a programme, as long as
1. the requirements for university admission are fulfilled at the time of recognition,
  2. the knowledge and skills to be recognised for the university degree programme are equivalent in both content and level to the course credits and examinations which they should replace, and
  3. the criteria for recognition have been verified in an accreditation.
- Knowledge and skills gained outside a university degree programme may not replace more than 50% of the university degree programme. Universities shall specify the details of the examination rules and regulations, in particular the extent to which knowledge and skills gained outside a university degree programme can be recognised and the preconditions that must be fulfilled. The examination rules and regulations may require the completion of a placement test.
- (7) In case of refresher courses, credits may be given for courses and examinations. When recognising credits from refresher courses for a university degree programme, Sections 2 and 5, as well as Section 6 Clause 1 No. 1 apply accordingly. When recognising knowledge and skills gained outside a university degree programme for refresher courses, Section 6 applies accordingly.

## **§ 7 Unexcused absences, withdrawal, deception and breaches of regulations**

- (1) An examination is graded as "failed" (5.0) if candidates fail to appear without being able to state a valid reason for their absence, or if they withdraw after the examination has started. A written examination that was not produced within the allocated time is also graded as "failed", unless the candidate is not responsible for the deadline being exceeded.
- (2) Plausible reasons for withdrawal or absence must be immediately addressed, in writing, to the examinations board. If the candidate, or a child for whom the candidate is generally the sole carer, is ill, a medical certificate must be provided. In case of doubt, the University may request a medical certificate from a doctor of its choice. If the reasons are accepted, a new appointment

will be scheduled. In this case, examination results that are already available will be taken into account.

- (3) When deciding whether the candidate is at fault for exceeding a deadline for registration, or taking an examination, the examinations board must respect the provisions stated in the Maternity Protection Act and the legal regulations concerning parental leave, and allow candidates to make appropriate use of these provisions.
- (4) If the candidate tries to influence the examination results through deception or by using unauthorised aids, the examination component in question will be graded as "failed" (5.0). If candidates disrupt the proper course of the examination, they may be excluded from further participation in the examination by the examiner or examination supervisor. In this case, the examination result will be graded as "failed" (5.0). In extreme cases, the examinations board may exclude the candidate from all further examinations.
- (5) Within a period of fourteen days, the candidate may request that the decision be validated by the examinations board in accordance with paragraph 4 clauses 1 and 2. The candidate must be informed of negative decisions immediately and in writing; the reasons for the decision must be stipulated and information on the procedure for appeal must be provided.

## § 8 Types of examination components

- (1) The examination components are:
  1. oral examination components completed during the course of study
  2. written examination components completed during the course of study (electronically where applicable)
  3. the Master's thesis
- (2) If candidates provide a medical certificate which credibly proves that they are not able to take examination components completely or partially in their intended form, due to long-term or permanent health problems, the examinations board may allow them to take an equivalent examination. The same applies to examination prerequisites.

## § 9 Oral examination components

- (1) In oral examination components, candidates must show that they are able to identify interconnections within the examination matter.
- (2) Oral examination components are administered by an examiner and a qualified observer. If there are numerous examiners, it is possible for one examiner to act as the observer.
- (3) An oral examination may last between 15 and 60 minutes.



- (4) Important content and the results of the oral examination must be written in the minutes. Candidates must be notified of examination results following the oral examination.
- (5) Students wishing to take a subject examination at a later examination date should be permitted to listen in on the same examination, if room is available. The audience may not be present for assessment or announcement of the examination results. Upon the candidate's request, or for other valid reasons, listeners may be prohibited from attending.

## § 10 Written examination components

- (1) In written examination components, candidates must demonstrate that they are able to recognise problems relating to their subject and find solutions for them, using subject-specific methods with limited time and resources.
- (2) A written examination may last between 45 and 180 minutes.
- (3) If a written examination is taken as a term paper, candidates must assure that they are the authors of their work and have used no sources or aids other than those indicated.

## § 11 Assessment of examination components

- (1) Grades for the individual examination components are determined by the respective examiners. The following grades must be used for assessment of examinations:
  - 1 = very good = an outstanding performance;
  - 2 = good = a performance which lies substantially above average requirements;
  - 3 = satisfactory = a performance which corresponds to average requirements;
  - 4 = sufficient = a performance which, despite deficiencies, still meets the requirements,
  - 5 = failed = a performance which does not meet the requirements due to considerable deficiencies.

To allow a more differentiated assessment of examination results, interim grades may be given by increasing or decreasing the individual grades by 0.3; the grades 0.7, 4.3, 4.7 and 5.3 may not be used.

- (2) In general, the evaluation period for examination components should not exceed two weeks following completion of the module.

- (3) Students receive a passing grade in an examination component if it has been graded as "sufficient" (4.0) or higher. A module is successfully completed when all individual sub-module examinations have been passed.
- (4) The module grade is calculated with the help of the sub-module examination grades averaged according to their credits.
- (5) When calculating final module grades and the overall examination grade, only the first digit after the decimal point is taken into account. The other digits are dropped without rounding.
- (6) The final module grade and overall Master's examination grade are designated as follows:
- |   |              |
|---|--------------|
| average of up to and including 1.5                    | very good    |
| for an average of between 1.6 and up to/including 2.5 | good         |
| for an average of between 2.6 and up to/including 3.5 | satisfactory |
| for an average of between 2.6 and up to/including 4.0 | sufficient   |
- (7) If grades are awarded in accordance with the European Credit Transfer System ECTS, the international assessment standard specified in Attachment 5 is applied.

## § 12 Retaking examination components

- (1) If examination components are not passed or are considered not to have been passed, they may be retaken once.
- (2) A second retake is only possible due to severe reasons and by request to the examinations board. A second retake is not possible for the module Master's thesis.
- (3) Retaking an examination that has been graded as passed is not permitted.
- (4) If an examination component is failed, it must be retaken within a reasonable timeframe (period of one year). If an examination component is failed once in a compulsory elective or elective module, the entitlement to take the final examination may be revoked. The credits required for completion of the Master's degree programme can be completed in a further relevant module.

## II. Master's examination

### § 13 Scope, nature and completion of the Master's examination

- (1) The Master's examination consists of:
1. examination components completed during the course of study in the modules, in accordance with Attachments 1 to 4



2. the Master's thesis
- (2) Examinations as referred to in paragraph 1 no. 1 are taken as an integrated part of the lecture or course. They can be in written or oral form. The lecturer responsible for a lecture or course determines the nature and duration of the examination components in accordance with paragraph 1 no. 1 and announces this information at the beginning of the lecture or course at the very latest.
- (3) Module examinations may consist of several sub-module examinations.

#### § 14 Admission requirements and procedure

- (1) Admission to the individual examination components is only authorised for students who:
  1. are enrolled in the Master's degree programme in Mathematics at Heidelberg University,
  2. have not lost their entitlement to take the final examinations in the Master's degree programme or diploma degree programme Mathematics, or in other degree programmes with comparable content, or in the teaching degree programme Mathematics.
- (2) Candidates who have completed examination prerequisites worth a total of 45 credits may be approved for the Master's thesis.
- (3) The decision on admission of the candidate is made by the chairperson of the examinations board.
- (4) The application for presentation of the Master's degree must be made in writing and addressed to the chairperson of the examinations board. Such an application must include the following documents:
  1. Evidence of examination prerequisites totalling 90 credit points according to the catalogue of compulsory and compulsory elective modules in mathematics (Attachments 1 to 4) as well as of the successfully completed Master's thesis;
  2. a declaration stating whether the candidate has previously failed a Master's examination or a final Diplom examination in either Mathematics or in degree programmes with comparable content, or has failed the Teacher Education Examination in the teaching degree programme Mathematics, or is currently participating in an examination procedure in one of the aforementioned degree programmes;
  3. a declaration stating that the candidate has not lost his/her entitlement to take the final examinations in the Master's degree programme in Mathematics.

- (5) The chairperson of the examinations board makes the decision on the application. Denials must be made in writing, stating the reasons and providing information on the procedure for appeal.
- (6) If candidates are unable to provide such evidence, the examinations board may accept other proof.
- (7) The application will be rejected, if
  1. conditions are not fulfilled in accordance with Section 1, or
  2. documents are not complete, or
  3. the candidate has failed the Master's examination or the Diplom examination in Mathematics, or in other degree programmes with comparable content or in the teaching degree programme Mathematics, or
  4. the candidate has lost his/her entitlement to take examinations in a degree programme according to No. 3 due to other reasons, or
  5. the candidate is currently undergoing examination procedures in a degree programme in accordance with no. 3.

## § 15 Master's thesis

- (1) The Master's thesis is an examination component that concludes the academic programme. The purpose of the Master's thesis is for candidates to show that they are able to work independently on a problem from the subject field of the degree programme in Mathematics within a given period of time and in accordance with the principles of scientific work.
- (2) The Master's thesis may be assigned and supervised by any authorised examiner in accordance with § 5, Section 2.
- (3) The topic of the Master's thesis will be determined by the thesis supervisor in consultation with the candidate. Where a corresponding application is filed, the examinations board chairperson shall ensure that said candidate receives a topic for their Master's thesis in due time. The candidate shall be given the opportunity to propose topics. However, this does not constitute a legal entitlement to a certain topic. The assignment is carried out by the chairperson of the examinations board; the date of the assignment must be put on record.
- (4) 30 credits are allocated for the Master's thesis. The deadline for submission of the thesis is six months after topic assignment. In exceptional circumstances, the examinations board may extend this deadline by a period of three months. If the deadline is exceeded, the Master's thesis will be graded as "failed" (5.0), unless the candidate is not responsible for the deadline being exceeded.

- (5) The topic, task and scope of the Master's thesis must be limited in such a way that the candidate is able to complete the thesis within the given time frame.
- (6) The thesis should contain a German and an English summary.
- (7) The Master's thesis may be written in German or English.

## **§ 16 Submission and assessment of the Master's thesis**

- (1) Three copies of the Master's thesis must be submitted to the examinations board before the deadline; the submission date must be recorded.
- (2) On submission of the Master's thesis, the candidate must assure in writing that they are the author of their own work and that no sources or aids other than those indicated have been used.
- (3) The Master's thesis is assessed by two examiners in accordance with § 5 Section 5. The first examiner should be the thesis supervisor. The candidate has the right to propose a topic, this does not, however, constitute a legal entitlement. The evaluation period should not exceed a period of four weeks.
- (4) The grade is calculated as the mean of both assessments; § 11 paragraph 5 applies accordingly. If the grades issued by the two examiners for the written thesis differ by more than one grade level, the examinations board shall determine the final grade of the written Master's thesis in consultation with the two examiners. In such cases, a third examiner may be consulted.
- (5) If the Master's thesis is graded as "failed" (5.0), it may be retaken on a new topic; retaking the thesis with the previous topic is not possible.
- (6) The Master's thesis may be presented to third parties if the candidate provides written consent.

## **§ 17 Passing the examination and overall grade**

- (1) The Master's examination is passed if all examination components completed during the course of study and the Master's thesis have been graded as "sufficient" (4.0) or higher.
- (2) § 11 applies for assessment of all examination components and the overall grade.
- (3) When calculating the overall grade for the Master's examination, all module grades (Attachments 1 to 4) and the Master's thesis are weighted according to the credits and multipliers.

## § 18 Master's diploma

- (1) Within four weeks of the Master's examination having been passed, a diploma will be issued. The diploma states all individual modules with their respective grades, credits, and the overall grade. The diploma bears the date of completion of the last examination component and must be signed by the chairperson of the examinations board.
- (2) A Diploma Supplement in German and English is included, which contains additional information about the course content and period of studies.

## § 19 Master's certificate

- (1) A Master's certificate is issued with the diploma, bearing the same date. It certifies the conferment of the academic degree.
- (2) The Master's certificate is signed by the Dean and the chairperson of the examinations board. It bears the faculty seal.
- (3) If the candidate has failed the Master's examination, a certificate will be issued on request and on presentation of relevant proof, listing passed examination components and the corresponding grades as well as the missing examination components. It is signed by the chairperson of the examinations board and includes a note about the Master's examination not having been passed. The same applies for the Master's examination, if it is failed on the final attempt.

## III. Final provisions

### § 20 Invalidity of examinations

- (1) If a candidate has deceived in an examination and this is only discovered after the diploma has been issued, the examinations board may accordingly change the examination results affected by the deception, and may declare the examination partially or completely failed.
- (2) If the candidate fails to fulfil the requirements for admission to the examination, but concealment of this failure was unintentional on the part of the candidate, and this failure is only discovered after the diploma has been issued, the passed examination is considered to compensate for this shortcoming. If the candidate intentionally deceived in order to gain admission to the examination, the examinations board will make a decision on the matter.
- (3) Before the decision is made, candidates will be given the opportunity to provide an explanation.

- (4) Fraudulent examination diplomas will be confiscated and, if necessary, a new diploma will be issued. If the examination is declared as “failed” as a result of discovered deception, then the Master's certificate will be confiscated along with the fraudulent examination diploma. In accordance with paragraph 1 and paragraph 2 clause 2, a decision may not be made more than five years after the date indicated on the examination diploma.

## **§ 21 Access to examination documents**

The candidate may request access to written examination documents, examiner reviews and the examination minutes within a period of one year after completion of the examination. The chairperson of the examinations board decides when and where access will be given.

## **§ 22 Coming into force**

These examination rules and regulations come into force on 1 September 2009.

## Attachment 1

### Programme structure MA degree Mathematics

#### 1. Year

Compulsory Elective Pure Mathematics I+II	16 CPS
Compulsory Elective Applied Mathematics I+II	16 CPS
Application areas I+II	18 CPS
2 Seminars	<u>12 CPS</u>
	62 CPS

#### 2. Year

Compulsory Elective Area of Specialisation I+II	16 CPS
Interdisciplinary skills	6 CPS
Master Seminar	30 CPS
Master's Thesis	<u>58 CPS</u>
	120 CPS

### Explanations and Comments

- (1) The modules are interchangeable in terms of which semester they are selected as long as this does not disrupt the sequence of the lectures.
- (2) If students want to broaden their basic knowledge, they may select max. two of the compulsory elective modules from the range of courses offered in the Bachelor's degree programme in Mathematics, provided that these modules were not included in the Bachelor's examination.
- (3) One seminar must be chosen in Pure Mathematics, the other in Applied Mathematics. The Master seminar must be taught by the Master's thesis supervisor.
- (4) Of the modules selected in the compulsory electives Pure and/or Applied Mathematics, at least 50% should, strictu sensu, be associated with these areas.
- (5) Students whose minor subject is Computer Science may replace one of the compulsory elective lectures in mathematics with a lecture from the area of theoretical computer science.
- (6) In agreement with the Master's thesis supervisor, 6 to 8 credits can be allocated for "Scientific Specialisation" based on guided literature reviews in the area of specialisation.

Interdisciplinary skills are not graded.



## Attachment 2

### Subject modules

#### F. Compulsory Electives Pure Mathematics

MG1 Algebraic Number Theory  
 MG2 Algebraic Number Theory II  
 MG3 Algebraic Geometry I  
 MG4 Algebraic Geometry II  
 MG5 Algebraic Groups I  
 MG6 Algebraic Groups II  
 MG7 p-adic Analysis I  
 MG8 p-adic Analysis II  
 MG9 Complex Analysis I  
 MG10 Complex Analysis II  
 MG11 Analytic Number Theory I  
 MG12 Analytic Number Theory II  
 MG13 Automorphic Forms I  
 MG14 Automorphic Forms II  
 MG15 Differential Geometry I  
 MG16 Differential Geometry II  
 MG17 Differential Topology I  
 MG18 Differential Topology II  
 MG19 Computer Algebra I  
 MG20 Computer Algebra II  
 MG21 Coding Theory

#### G. Compulsory Electives Applied Mathematics

MH1 Non-linear Functional Analysis  
 MH2 Harmonic Analysis  
 MH3 Partial Differential Equations II  
 MH4 Special Topics in Analysis  
 MH5 Numerical Linear Algebra  
 MH6 Numerical Mathematics of Ordinary Differential Equations  
 MH7 Numerical Mathematics of Partial Differential Equations  
 MH8 Numerical Optimisation of Differential Equations  
 MH9 Numerical Methods in Continuum Mechanics  
 MH10 Special Topics in Numerical Mathematics  
 MH11 Special Topics in Optimisation  
 MH12 Statistics II  
 MH13 Probability Theory II  
 MH14 Predictability and Complexity I  
 MH15 Predictability and Complexity II  
 MH16 Algorithmic Optimisation I  
 MH17 Algorithmic Optimisation II  
 MH18 Pattern Recognition  
 MH19 Image Processing

#### H. The area of specialisation

can, depending on the study focus, be composed of advanced lectures from the areas F. or G. as well as from current special lectures or from the module “Scientific Specialisation”.

### Explanations and Comments

(1) At least 3 modules in the compulsory electives Pure and/or Applied Mathematics are included in the range of courses every semester.

**Attachment 3****Interdisciplinary Skills**

Mathematical Colloquium, contingent semester	2 - 6 CPS
Software lab course, contingent on workload	3 - 6 CPS
Industry internship, contingent on duration	3 - 6 CPS
Participation in holiday courses or summer schools	3 - 6 CPS
Semester abroad, contingent on amount	3 - 6 CPS
Tutoring position, contingent on number of semesters	3 - 6 CPS
Interdisciplinary Skills from the programmes offered at the university	up to 6 CPS

**Attachment 4****Application Areas**A.Computer Science

Compulsory Elective Computer Science I	9 CPS
Compulsory Elective Computer Science II	9 CPS
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	18 CPS

B.Physics

Theoretical Physics III+IV	16 CPS (+2)
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	16 CPS (+2)
or	
Experimental Physics III+IV	14 CPS (+2)
Seminar	2 CPS
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	16 CPS (+2)

C.Astronomy

Observational Methods (lecture + practice class)	8 CPS
Theoretical Astrophysics (lecture + practice class)	8 CPS
Seminar	2 CPS
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	18 CPS

D.Biology

Biology IV	9 CPS
Compulsory Elective Biology	9 CPS
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	18 CPS

E.Organic

Chemistry	9 CPS
Lab Course Organic Chemistry	9 CPS
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	18 CPS

F.Economics

Microeconomics (MSc E 1A)	8 CPS (+1)
Macroeconomics (MSc E 1B)	8 CPS (+1)
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	16 CPS

G.Philosophy  
2 main seminars

18 CPS

### Explanations and Comments

(1) The application area should build on the application area chosen in the Bachelor's degree programme.

The degree programmes presented in the application area are merely suggestions. They may be replaced by other comparable module combinations in agreement with the Dean of Studies.

## Attachment 5

### Grading in accordance with ECTS

ECTS grades are awarded for successfully completed examination components and are assigned as follows:

- A the top 10 %
- B the following 25 %
- C the following 30 %
- D the following 25 %
- E the following 10 %

Data may be collected from one examination date, or one or several academic years. The basis of the data is disclosed with the ECTS grade.

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