UNIVERSITY OF AMSTERDAM

FACULTY OF SCIENCE

TEACHING AND EXAMINATION REGULATIONS

PART B

ACADEMIC YEAR 2020-2021

MASTER PROGRAM

S T O C H A S T I C S
A N D
F I N A N C I A L M A T H E M A T I C S

Chapter 1 General provisions

Article B-1.1 *Definitions*

In addition to TER Part A, the following definitions are used in TER Part B:

a. Personal Education Plan (PEP): An individual study plan for the student's master programme.

b. Master Project: Compulsory internship or master thesis resulting in a written report.

c. Mastermath: a collaboration of nine Dutch universities offering Masters in mathematics.

Article B-1.2 *Degree programme information*

§1. The Master Stochastics and Financial Mathematics (SFM) with CROHO number 60801, is offered on a full-time basis. The language for the program is English.

§2. The programme has a workload of 120 EC and is offered in collaboration with Mastermath.

§3. Students choose between a regular programme and programmes with a major or minor. Each major and minor has its specific exit qualifications (see Appendix 3).

§4. The student may choose a major or a minor from the list below (see also *Article B-4.1*).

Major (60 EC)	Minor (30 EC)
Science Communication	Teaching (in Dutch)
Science in Society	Tesla
Teaching (in Dutch)	Science for Sustainability

Article B-1.3 *Entry date*

The programme is offered starting in the first semester of an academic year (1 September). This entry date ensures the curriculum can be completed within the nominal time period.

Chapter 2 Programme objectives and exit qualifications

Article B-2.1 *Program objectives*

§1. The programme aims to provide students with knowledge, abilities and insight in the field of stochastics and financial mathematics, to enable them to work as an academic professional, or to become qualified to pursue advanced training as scientific researcher.

§2. The programme also aims at furthering the insight in the role and understanding of the discipline and its practitioners in society.

Article B-2.2 *Exit qualifications*

§1. The student graduating from the programme:

a. has a thorough theoretical and practical knowledge of modern stochastics and financial mathematics, including the necessary knowledge of other disciplines required for that purpose;

b. has insight in the development and heuristics of modern stochastics and financial mathematics, in particular in stochastics;

c. has research experience in stochastics and financial mathematics;

d. can formulate a research plan based on a relevant problem analysis in the field of stochastics and financial mathematics;

e. is able to analyse and formulate research results and to draw conclusions from them;

f. is able to write a scientific report;

g. is able to participate in discussions about mathematical problems with fellow researchers;

h. is able to consult and apply international professional literature in the relevant sub-areas;

i. is able to apply the knowledge of stochastics and financial mathematics in a broader, multidisciplinary, context;

j. is employable in those positions in which knowledge and research skills especially in the field of

stochastics and financial mathematics are a prerequisite;
k. has in depth knowledge of, and insight in the social role of stochastics and financial mathematics to make sound choices regarding one's own profession, as well as in the exertion of this profession;
l. is able to cooperate with other people, to convey knowledge to other people and to give a presentation both to discipline specialists and to a broader audience;
m. is aware of potential ethical implications of the use of mathematics and mathematical models within the field of stochastics and financial mathematics.

§2. In addition to §1, a student completing the regular programme (see *Article B-4.1*) is able to
a. place obtained results and conclusions in the context of results obtained by other scientists;
b. carry out literature research in stochastics and financial mathematics using various sources, and combine and enrich these with personal contributions;
c. develop a vision on the development of scientific research in the field of study; model observations in (probabilistic theoretical) mathematical terms, to analyse this model and to draw conclusions from these observations.

§3. The final attainment levels of the major and minor programmes and the learning outcomes of the minor Tesla are listed in Appendix 3. See also https://tinyurl.com/ya4kkfrt.

Chapter 3 Further admission requirements

Article B-3.1 *Admission requirements*

§1. Students having completed a Bachelor's degree Wiskunde awarded by a Dutch University, with basic knowledge of measure and integration theory, probability and statistics may be admitted.

§2. Students who have completed a Bachelor's degree in Econometrics may be admitted when making up for deficiencies in measure and integration theory and other deficiencies in analysis.

§3. Without prejudice to the provisions of §1, the Admissions Board may grant admission to the study programme when concluding that the previous education of the candidate is equivalent to the Bachelor's degree referred to in §1.

Article B-3.2 *Pre-master's programme*

§1. Without prejudice to the provisions of *Article B-3.1* the Admissions Board may grant admission to a student whose previous education does not meet aforementioned admission requirements to the study programme, when concluding that the candidate is able to meet these admission requirements within a reasonable period of time. At the request of a candidate, and when the Admissions Board has decided additional education feasible, the Admissions Board may draw up a programme of at most 30 EC as an admission requirement, a so-called Pre-master's programme.

§2. After successful completion of this Pre-master's programme a letter of admission will be issued, exclusively for the stated Master's programme.

Article B-3.3 *Limited programme capacity* Not applicable.

Article B-3.4 *Final deadline for registration*

A request for admission to the Master's programme must be received before June 30, 23.59 CEST for EU/EEA/Swiss students, and before January 31, 23.59 CEST for non-EU/EEA/Swiss students. Under exceptional circumstances, the Admissions Board may consider a request submitted after these intake dates.

Article B-3.5 *English language requirements*

§1. The proficiency requirement in English as the language of instruction can be met by the successful completion of one of the following examinations:

a. IELTS (minimal result 6.5 and at least 6 for sub-scores for listening, reading, writing, speaking);
b. TOEFL (paper-based with minimal result 580; or internet-based with minimal result 92, and at least 22 for the sub-scores for listening, reading, writing, speaking);
c. Cambridge Advanced English: A, B or C.

The foregoing examination must have been taken within two years before the enrollment.

§2. An exemption from the English examination in §1 shall be granted to students who:

a. had previous secondary or tertiary education in one of the following English-speaking countries: Australia, Canada (English), New Zealand, Ireland, the UK or the USA;
b. hold an English-language international baccalaureate diploma;
c. possess a Bachelor's degree from a Dutch university requiring sufficient command of English;
d. passed the final examination English as part of the VWO or the ASO (Flemish) diploma.

Chapter 4 Curriculum structure

Article B-4.1 *Composition of the degree programme*

§1. Students structure their program in one of the following three ways:

a. the regular programme;
b. the programme with minor;
c. the programme with major.

The curriculum that corresponds to each of these choices is outlined in the below table.

programme components	the regular programme	programme with minor	programme with major
Master Seminar SFM	3 EC	3 EC	3 EC
Measure Theoretic Probability	8 EC	8 EC	8 EC
Master Project SFM	36 EC	24 EC	24 EC
Restricted-choice electives	61 EC	43 EC	25 EC
Free -choice electives	12 EC	12 EC	
Minor or Major		30 EC	60 EC
Total EC	120 EC	120 EC	120 EC

The majors and minors are listed in *Article B-1.2*. The contents of the study programme are determined in consultation with the Master Coordinator, and laid down in a Personal Education Programme (PEP). Students then submit their PEP for approval to the Examinations Board.

§2. All students (regular programme, programme with minor, programme with major) take the following compulsory components:

a. Master Seminar in Stochastics and Financial Mathematics;
b. Measure Theoretic Probability.

Students from the regular program and students from the program with minor choose one of the following specializations:

Acronym	Specialization
DAS	Data Analysis and Statistics
FNM	Financial Mathematics
PDM	Probability and Decision Making

The 61EC restricted-choice electives for the regular programme and the 43EC restricted-choice electives for the programme with minor (see the table in §1) must:

a. all be selected from the complete SFM Curriculum listed in Appendix 1;
b. satisfy the additional restrictions formulated in Appendix 2.

§3. Students of the regular program and students of the regular program with minor who wish to deviate from the restrictions as in §2 may formulate an alternative Personal Education Plan, including a topic of the Master Project SFM. This should be done in consultation with the Master Coordinator and submitted for approval to the Examinations Board before execution.

§4. The 30 EC Minor Tesla takes place in the second semester of the second year. It has a separate intake procedure for admission and has limited capacity. The Minor Tesla requires that students have finished 48 EC of their research programme before they can participate.

§5. Students of the program with major go through a separate intake procedure for admission into the major. Each major must be combined with a 60EC research programme, and each major requires that students have completed 48EC of this research programme before they can participate. The research programme consists of the following components (see table in §1):

a. a smaller sized 24EC Master Project SFM;
b. the 3EC Master Seminar SFM;
c. the 8EC course Measure Theoretic Probability;
d. a least 25EC elective components related to the topic of the Master Project.

The elective components must be selected from Appendix 1 in consultation with the Master Coordinator and approved by the Examinations Board before commencing. They do not have to satisfy the requirements detailed in Appendix 2 for the specializations from §2.

§6. The 60EC Major Teaching offered by the Interfacultaire Lerarenopleidingen (ILO) results in the first-degree teaching competency (Dutch: eerstegraads bevoegdheid). Students who already have the second-degree teaching competency (tweedegraads bevoegdheid), for example by having completed the Educatieve Minor in the Bachelor, can obtain the first-degree teaching competency by following a reduced 30EC program at ILO. The program should then be implemented as a program with minor (see §1-4). An alternative implementation may be possible, but only after consultation with both Major- and Master Coordinator and approval by the Examinations Board.

Article B-4.2 *Compulsory units of study*

§1. The Master Seminar SFM is compulsory. Its content, format, and assessment criteria are described in the Course Catalogue.

§2. Measure Theoretic Probability is a compulsory course.

§3. The Master Project SFM is compulsory.

a. The Master Project SFM is conducted under the supervision of an examiner, and consists of a thesis, a midterm presentation in the Master Seminar SFM or in the Master Seminar Stochastics of the Master Mathematics, and a final presentation.

b. At the end of the Master Project SFM the examiner verifies on the basis of the assessment criteria, whether the student has sufficiently achieved the exit qualifications.

The assessment criteria are the:
1. quality and content of the written thesis (50%);
2. student's attitude and execution of the project (35%);
3. midterm presentation (5%);
4. final presentation (10%).

c. Concerning the assessment of the Master Project SFM:
1. a second examiner will act as an independent reviewer;
2. the coordinator of the Master Seminar SFM/Stochastics will assess the midterm presentation;
3. the final presentation will be attended by the examiner and the second reviewer;
4. the final grade will be determined by the examiner and the second reviewer;
5. a member of the Examinations Board will supervise the assessment procedure.

Article B-4.3 *Practical exercise* Not applicable.

Article B-4.4 *Electives*

§1. The restricted-choice elective courses are all listed in Appendix 1.

§2. Course components successfully completed elsewhere or that are not included in the list of restricted-choice elective components may be included in the student's Personal Education Plan (PEP) only subject to prior permission from the Examinations Board. Such course components:

a. have to be offered by an accredited university or institute that is of a comparable level;
b. must be relevant to the programme;
c. must have been completed during the period that the student is enrolled in the programme.

§3. In terms of content, restricted-choice elective components must not show too much similarity to other components of the student's PEP. The acceptable degree of similarity is to be decided by the Examinations Board.

§4. The contents and assessment method of Reading Course Mathematics (6EC) and Reading Course (3EC) needs to be approved by the Examinations Board prior to the start of the course. The examiner of the reading course sends in a request for approval to the Examinations Board, containing a short description of the content, the reading material, and the assessment procedure.

§5. The restricted-choice elective course Internship SFM (3EC) is a course in which students do a summer internship at a financial or consultancy company.

§6. The free-choice elective components:

a. must not show too much overlapping content with other components in student's PEP;
b. may in exceptional cases be at Bachelor level.

They will only be accepted as part of PEP if the Examinations Board has given its prior approval.

Article B-4.5 *Free curriculum*

§1. Subject to certain conditions, students have the option to compile a curriculum of their own choice, which deviates from the curricula stipulated by the degree programme.

§2. The composition of this curriculum must first be approved by the Examinations Board.

§3. It must possess at least the extent, breadth and depth of the regular programme described in *Article B-4.1* and must be in line with the learning outcomes of the degree programme as formulated in *Article B-2.2*. At least 60EC of the proposed curriculum must consist of components of the regular programme and must include the Master Seminar SFM and the Master Project SFM.

Article B-4.6 *Sequence of examinations*

§1. Participation in a restricted-choice elective course may require particular mathematical prerequisites. The prerequisites for each course are listed in the Course Catalogue.

§2. The Master Project SFM in the regular programme may only be commenced if the other compulsory course components and the restricted-choice elective components have been completed.

Article B-4.7 *Further conditions for registration for examinations* Not applicable.

Article B-4.8 *Further conditions for examination opportunities* Not applicable.

Article B-4.9 *Participation practical training and tutorials* Not applicable.

Article B-4.10 *Further conditions for exemption*

§1 A maximum of 60 EC of the curriculum may be obtained through granted exemptions.

Article B-4.11 *Validity period of results* Not applicable.

Article B-4.12 *Degree*

A student who passes the final examination of a programme is awarded a Master of Science degree. The name of the degree awarded is stated on the diploma.

Article B-4.13 *Mastermath*

Students taking courses as part of Mastermath may also be subject to rules and regulations that have been agreed on nationally. See the General Rules & Guidelines at http://elo.mastermath.nl.

Article B-4.14 *Double Degree Programme (SFM and other two-year programmes)*

In case a student combines two other Master programmes of 120 EC and their components, the following requirements must be met in order to be awarded two Master's degrees:

§1. The total programme of the candidate should amount to at least 180 EC credits.
§2. The two master programmes may not show too much similarity.
§3. The student's work for the programme (lectures, research work, etc.) must be of such a standard that all the exit qualifications of each of the two programmes are met.
§4. The student must have conducted separate research work for both Master's degrees. This may consist of two separate research projects with supervisors from the respective study programmes. In the case of an integrated research project, this must be supervised by examiners from the two Master's programmes. The project must be assessed as a pass by both examiners according to the standard and procedures for Master project assessment of the respective master degrees. The total number of credits given for an integrated research project is 3/4 of the sum of the credits given for two independent research projects.
§5. In addition to §1-4, the other study programme may impose further requirements.
§6. The Examinations Boards of both study programmes must approve the student's double Master's programme before the student commences with the double Master's programme.

Article B-4.15 *Double Degree Programme SFM and Econometrics*

A student can be awarded both the Master's degrees SFM and Econometics after successfully completing the programme described below. The student must have been admitted to both Master programmes separately.

§1. The total study load of the Double Degree Programme is at least 150 EC.
§2. The student's work for the Master's programme (lectures, research work etc.) is of such a standard that all exit qualifications of each of the two programmes have been met. The specific programme requirements for double degree students are described in the document Double degree programmes in Econometrics and Mathematics/SFM, which is available at the study guide pages of the master programmes. See https://tinyurl.com/y94op57m.
§3. The candidate has conducted an integrated research project Master Project Econometrics and SFM (36 EC), replacing the Master Project SFM. This must be supervised by examiners and independent second reviewers from each of the two Master's programmes. The project must be assessed as a pass by the examiners according to the standards and procedures for Master project assessment of the respective master degrees.
§4. The Examinations Boards of both study programmes must approve the student's double Master's programme before the student commences with the double Master's programme.

Chapter 5 Academic student counseling

Article B-5.1 *Academic student counseling*

The programme's academic student counseling consists of Master Coordinator and Study Adviser.

Chapter 6 Teaching evaluation

Article B-6.1 *Teaching evaluation*

Teaching evaluation takes place via the UvA Q course evaluation system, by peer review of exams and resit, and quality assessment by the Program Committee and by the Examinations Board.

Chapter 7 Transitional and final provisions

Article B-7.1 *Amendments and periodic review*

§1. Amendments to Section B of the Teaching and Examination Regulations shall be adopted by the dean after taking advice from the relevant Programme Committee. A copy of the advice will be sent to the authorised representative advisory body.

§2. Amendments to Section B of the Teaching and Examination Regulations shall require the approval of the Faculty representative advisory body for components that do not relate to the subject matter of Section 7.13, subsection 2, under a−g, as well as subsection 4, of the WHW. Components related to the subjects of Section 7.13, paragraph 2, under (v) must be submitted to the Faculty representative advisory body for advice.

§3. Amendments to the Teaching and Examination Regulations may only pertain to an academic year that is already in progress if it can be shown that this does not harm student's interests.

Article B-7.2 *Transitional provisions*

§1. The following course components of the past academic year have been canceled:

Canceled course components from the academic year 2019-2010
Advanced Topics in Stochastic Analysis
Mathematical Optimisation
Percolation: from Introduction to Frontiers of Current Research
Planning and Reinforcement Learning
Probabilistic and Extremal Combinatorics
Random Walks
Statistics for Life Sciences
Statistics for Stochastic Processes
Topological Data Analysis

§2. The following two courses have been renamed. Each of these two courses can only appear under one of its two names in student's Personal Education Plan.

previous name	new name as of 2020-2021
Stochastic Optimization	Dynamic Programming and Reinforcement Learning
Entrepreneurship in Data Science	Entrepreneurship in Analytics and AI

§3. These regulations apply to anyone enrolled in the programme. However, regarding the curriculum requirements as stated in *Article B-4*, the student may make an appeal to the regulations of the academic year of the student's enrollment in the programme.

Article B-7.3 *Publication*

§1. The dean shall ensure a fitting publication of part A and B of these Regulations and the rules and guideline referred to in the Act.

§2. They can be accessed at the website of the Faculty of Science and the UvA Course Catalogue.

Article B-7.4 *Effective date*

These Regulations enter into force with effect from 1 September, 2020.
Thus drawn up by the Dean of the Faculty of Science on ?? August, 2020.

Appendix 1 Description of the content and study load of the components

All courses have lectures and/or tutorials and are assessed by a written or oral exam, apart from the 3EC and 6EC Reading Courses, which are a literature study with alternative examination.

Course Name	Code	EC	Period
Advanced Machine Learning	53348ADM6Y	6	1,2
Asymptotic Statistics	5374ASST8Y	8	1,2
Bayesian Statistics	5334BAST8Y	8	4,5
Causality	5334CAUS6Y	6	4,5
Complex Networks	5374CONE8Y	8	4,5
Computational Finance	5284COFI6Y	6	4
Data-driven Decision Making in Operations Research	5334DDDM6Y	6	4,5
Dynamic Programming and Reinforcement Learning	53348DPR6Y	6	1,2
Entrepreneurship in Analytics and AI	53348EIA6Y	6	4,5
Ergodic Theory	53348ERT8Y	8	1,2
Forensic Probability and Statistics	5334FOPS8Y	8	1,2
Functional Analysis	53348FUA8Y	8	1,2
Interacting Particle Systems: Theory & Applications	5334IPST8Y	8	1,2
Interest Rate Models	5374INRM6Y	6	1,2
Machine Learning Theory	5334MALT8Y	8	4,5
Measure Theoretic Probability	5374METP8Y	8	1,2
Nonparametric Statistics	5334NOST6Y	6	4,5
Optimisation of Business Processes	53348OPB6Y	6	4,5
Partial Differential Equations	53348PAD8Y	8	1,2
Performance of Networked Systems	52848PEN6Y	6	4,5
Portfolio Theory	5374POTS6Y	6	1,2
Queueing Theory	53748QUT6Y	6	4,5
Queues and Levy Fluctuation Theory	5334QLFT6Y	6	4,5
Reading Course	53342RCM6Y	3	1,2,3,4,5,6
Reading Course Mathematics	5334RECM6Y	6	1,2,3,4,5,6
Scheduling	53748SCH6Y	6	4,5
Simulation Methods in Statistics	5374SIMS6Y	6	1,2
Statistical Models	53348STM6Y	6	1,2
Statistics for Networks	53748STF6Y	6	4,5
Stochastic Integration	5374STIN8Y	8	4,5
Stochastic Networks	5334STNE6Y	6	1,2
Stochastic Processes	53748STP8Y	8	4,5
Stochastic Processes for Finance	53748SPF6Y	6	1,2
Stochastic Simulation	5334STSI6Y	6	1,2
Time Series	53748TIS8Y	8	4,5
Uncertainty Quantification & Data Assimilation	5334UQDA6Y	6	1,2
Wavelets	5334WAVE6Y	6	1,2
Internship SFM	5374ISFM3Y	3	6
Master Seminar SFM	5374MSSF3Y	3	1,2,3,4,5,6
Master Projects:			
SFM	5334MPM36Y	36	1,2,3,4,5,6
SFM (with Major or Minor)	5334MPM36Y	24	1,2,3,4,5,6
SFM & Econometrics		36	1,2,3,4,5,6

The Master Seminar SFM has the format of lectures and student presentations. The latter are assessed to determine the grade. The Internship SFM is assessed by a presentation and the input from the company supervisor. The Master Projects are assessed as described in *Article B-4.2,§3*.

Appendix 2 Restrictions on the restricted-choice electives

Here we list the further restrictions on the restricted-choice elective courses related to each of the specialisations mentioned in *Article B-4.1, §2*.

Data Analysis and Statistics	
take the 2 compulsory courses:	select 2 from:
Asymptotic Statistics Machine Learning Theory	Causality Simulation Methods in Statistics Stochastic Simulation Time Series

Financial Mathematics	
take the 3 compulsory courses:	select 2 from:
Asymptotic Statistics Stochastic Integration Internship SFM[1]	Computational Finance Interest Rate Models Portfolio Theory Stochastic Processes for Finance

[1] needs only be taken if the Master Project SFM does not contain an internship.

Probability and Decision Making	
take the 3 compulsory courses:	select 2 from:
Data-driven Decision Making in OR Stochastic Processes Stochastic Simulation	Entrepreneurship in Analytics and AI Machine Learning Theory Queueing Theory Queues and Lévy Fluctuation Theory

Appendix 3 A. Final attainment levels of the major Teaching (in Dutch)

§1. De bekwaamheidseisen Leraar Voorbereidend Hoger Onderwijs zijn, naast de voor alle wo-masteropleidingen geldende Dublin-descriptoren en algemene wettelijke eisen, richtinggevend voor de doelstellingen en eindtermen van de lerarenopleidingen Voorbereidend Hoger Onderwijs. Deze bekwaamheidseisen zijn vastgelegd in de Wet op het voortgezet onderwijs (artikel 36 e.v.) en het Besluit bekwaamheidseisen onderwijspersoneel (zie het 'Besluit bekwaamheidseisen onderwijspersoneel' (http://wetten.overheid.nl/BWBR0018692) en 'Besluit van 16 maart 2017 tot wijziging van het Besluit bekwaamheidseisen onderwijspersoneel en het Besluit bekwaamheidseisen onderwijspersoneel BES in verband met de herijking van de bekwaamheidseisen voor leraren en docenten' (https://zoek.officielebekendmakingen.nl/stb-2017-148.html).

De eindtermen zijn geordend in twee categorien:

a. Eindtermen 1, 2, 3:

deze hebben rechtstreeks te maken met de kern van het beroep: het onderwijsleerproces en het leren van leerlingen, te weten de vakinhoudelijke, vakdidactische en pedagogische bekwaamheid;

b. Eindtermen 4 en 5:

deze hebben betrekking op de meer algemene aspecten van professioneel handelen ten dienste van die kern van het beroep: te weten samenwerking met collega's en de omgeving van de school en met reflectie en persoonlijke en professionele ontwikkeling.

De opleiding draagt er zorg voor dat de afgestudeerde Leraar VHO in ieder geval:

1. aantoonbaar beschikt over vakinhoudelijke kennis en vaardigheden die het wo-bachelorniveau overstijgen dan wel verdiepen, en dus:

a. de inhoud van vak beheerst / boven de leerstof staat;
b. daardoor de leerstof, voor het schooltype waarin de leraar werkzaam is, zo kan samenstellen, kiezen of bewerken dat de leerlingen die kunnen leren;
c. vanuit vakinhoudelijke expertise verbanden kan leggen met het dagelijks leven, met werk en met wetenschap en het onderwijs betekenisvol kan maken voor de leerlingen;
d. daarmee kan bijdragen aan de algemene vorming van de leerlingen.

2. aantoonbaar beschikt over vakdidactische kennis en vaardigheden, en dus:

a. de vakinhoud weet te vertalen in leerplannen of leertrajecten en dat doet op een professionele, ontwikkelingsgerichte werkwijze;
b. de vakinhoud leerbaar maakt voor en afstemt op het niveau en kenmerken van de leerlingen, daarbij doelmatig gebruikmakend van (digitale) beschikbare leermiddelen;
c. het onderwijs kan ontwikkelen en evalueren;
d. het onderwijs doelmatig kan uitvoeren en het leren van leerlingen kan organiseren;
e. de vak inhoud/didactiek afstemt met de collega's op school en laat aansluiten bij de visie en missie van de school.

3. aantoonbaar beschikt over pedagogische kennis en vaardigheden, en dus:

a. de ontwikkeling van leerlingen volgt in hun leren en gedrag en daarop het handelen afstemt;
b. bijdraagt aan de sociaal-emotionele en morele ontwikkeling van de leerlingen;
c. bijdraagt aan de burgerschapsvorming en de ontwikkeling van de leerling tot een zelfstandige en verantwoordelijke volwassene;
d. met een professionele, ontwikkelingsgerichte werkwijze en in samenwerking met collega's een veilig, ondersteunend en stimulerend leerklimaat voor leerlingen kan realiseren;
e. in staat is om oordelen te formuleren, rekening houdend met de sociaal-maatschappelijke en ethische verantwoordelijkheden die horen bij het beroep

4. aantoonbaar reflecteert ten behoeve van persoonlijke en professionele ontwikkeling, en dus:

a. in staat is kritisch te reflecteren op alle aspecten die met zijn/haar persoonlijkheid, motivatie, attitudes, verwachtingen en cognities te maken hebben (die onder meer tot uiting komen in het pedagogisch handelen) en feedback hieromtrent ter harte te nemen

b. op onderzoeksmatige wijze de (eigen) onderwijspraktijk verbetert en blijft ontwikkelen;
c. in staat is (vak)kennis en -kunde actueel te houden;
d. in staat is een eigen positie te bepalen t.a.v. de missie en visie van de school en bereid een constructieve bijdrage te leveren aan de ontwikkeling van het vak/het onderwijs in de school.

5. aantoonbaar samenwerkt en communiceert met collega's en omgeving, en dus:

a. het pedagogisch handelen kan afstemmen met collega's en met anderen die voor de ontwikkeling van de leerling verantwoordelijk zijn;
b. de ontwikkeling van het vak/curriculum in de school kan afstemmen met collega's en met anderen die voor de ontwikkeling van de leerling verantwoordelijk zijn.

§2. Onverminderd het bepaalde in §1 heeft afgestudeerde van afstudeerrichting Biologie een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Biologie en kan op basis daarvan aantrekkelijke, effectieve en efficiïte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Biologie in de onder- en/of bovenbouw.

§3. Onverminderd het bepaalde in §1 heeft afgestudeerde van afstudeerrichting Natuurkunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Natuurkunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Natuurkunde in de onder- en/of bovenbouw.

§4. Onverminderd het bepaalde in §1 heeft afgestudeerde van afstudeerrichting Scheikunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Scheikunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Scheikunde in de onder- en/of bovenbouw.

§5. Onverminderd het bepaalde in §1 heeft de afgestudeerde van afstudeerrichting Wiskunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Wiskunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Wiskunde in onder- en/of bovenbouw.

§6. Onverminderd het bepaalde in §1 heeft afgestudeerde van afstudeerrichting Aardrijkskunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Aardrijkskunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het vak Aardrijkskunde in de onder- en/of bovenbouw.

B. Final attainment levels of the major Science Communication

The master graduate possesses an academic attitude, skills and competences to operate at the interface of science and society aiming to contribute to a fruitful science-society dialogue. This means that the master graduate has the following focus:

a. Understanding the dynamic relationship between science and society;
b. Translating information from the natural sciences to society and vice versa;
c. Shaping the dialogue between science and society.

Graduates have the following knowledge:

§1. Knowledge of and insight into the relevant concepts and theories in the field of science communication, sociology, communication science, philosophy and science & technology studies in relation to the natural sciences;

§2. Familiarity with scientific journals in the field of science communication and science & technology studies, as well as familiarity with a variety of popular-scientific media;

§3. Insight into the nature and course of interpersonal and group communication processes relevant to the formal and informal dialogue between science and society;

§4. Insight into relevant concepts and theories for effective communication and collaboration in relation to diverse science-society interactions;

§5. Insight into the popularization of the natural sciences in various media;

§6. Insight into the roles and responsibilities of museums in science communication.

Graduates have the following skills:

§1. Independently acquire, analyze and evaluate relevant information in a variety of scientific disciplines, by conducting literature study and empirical research;

§2. Communicate and collaborate effectively with diverse professionals of scientific and nonscientific disciplines as well as lay citizens;

§3. Design and facilitate interactive processes in relation to the science-society dialogue;

§4. Translate information from various natural science disciplines into more generally accessible language and formats;

§5. Produce popular-scientific media output concerning developments in the natural sciences, aimed at a variety of publics;

§6. Contribute to the design of museum exhibitions from the perspective of scientific content management and science communication theory;

§7. Contribute intrinsically to the societal discussion of developments in science and technology

C Final attainment levels of the major Science in Society

Dublin descriptor 1 *Knowledge and understanding*

The graduate has theoretical and practical knowledge of management, policy analysis and entrepreneurship. The graduate has insight into:

§1. the various relevant disciplines in the social and behavioural sciences. More specifically the student acquires insight into:
a. concepts and theories in the field of policy science, management studies, and entrepreneurship;
b. the relation of these gamma sciences to the beta sciences.

§2. concepts and the latest theories, research methodologies, analytical models and important research questions related to interdisciplinary research for addressing societal problems;

§3. and has knowledge of concepts and theories for effective communication and collaboration.

Dublin descriptor 2 *Applying knowledge and understanding*

The graduate is experienced in carrying out interdisciplinary research, in applying techniques specific to the subject area and in applying scientific knowledge to societal problems. The graduate:

§1. can integrate knowledge from the beta and gamma sciences, and from science and practice;

§2. can apply scientific knowledge to formulate solutions to societal problems and assess them for appropriateness and societal relevance;

§3. adopts an appropriate attitude towards the correct and unbiased use and presentation of data.

Dublin descriptor 3 *Making judgments*

The graduate is able to independently and critically judge information. The graduate is able to:

§1. independently acquire information in relevant scientific areas through a literature review and by conducting empirical research, as well as evaluate such information critically;

§2. select and order information, distinguish essentials from trivialities, and recognize connections;

§3. formulate personal learning objectives and critically evaluate own performance, both introspectively and in discussion with others.

Dublin descriptor 4 *Communication*

The graduate is able to transfer knowledge and skills related to his/her subject area to other people and to adequately reply to questions and problems posed within society. The graduate:

§1. has acquired skills to report orally and in writing on research results in English;

§2. has the ability to communicate research conclusions, and the knowledge and rationale underpinning them, to specialist audiences and non-specialist audiences clearly and unambiguously;

§3. can collaborate with researchers from various scientific disciplines;

§4. can contribute to scientific discussions about plans, results and consequences of research.

Dublin descriptor 5 *Learning skills*

The graduate has developed learning skills that enable him/her to continue with self-education and development within the subject area. The graduate:

§1. has acquired skills to develop a research plan, giving details of the problem statement, objectives, research questions, research approach, research methods, and planning;

§2. is familiar with the general scientific journals, such as Nature and Science, and with journals in the specialisation, such as Research Policy, Health Policy, Science, Technology & Human Values, Social Science & Medicine, and International Journal on Technology Management;

§3. has the learning skills to allow him/her to continue to study in a manner that may be largely self- directed or autonomous (life-long learning).

D. Final attainment levels of the minor Science & Sustainability

After completing the Minor Science for Sustainability, students have:

1. awareness of the interdependence of the global natural system, the social system and the human system as well as of the importance of the coherence that is required between them to produce effective, science-based sustainable solutions;
2. developed a view on complex sustainability issues while maintaining a clear focus on one specific disciplinary domain, in which they develop further scientific knowledge and expertise;
3. learned how sustainable solutions can be realized via system innovations and transition management;
4. become acquainted with an interdisciplinary approach in developing sustainable, science-based solutions for urgent societal challenges, including their economic and policy aspects;
5. learned to work collaboratively in an interdisciplinary student project.

E. Learning objectives of the minor Tesla

By completing the Tesla Minor the graduate is fit to start a career in demanding environments which require abilities to utilize the disciplinary science background in research, corporate, civil society, governmental and advisory work environments.

All learning objectives fall into at least one of the following categories:

1. Information processing;
2. Teamwork;
3. Project Work;
4. Communication;
5. Self-reflection.

More information on the minor Tesla can be found in the study guide: http://www.teslaminor.nl

F. Final attainment levels of the minor Educatie

§1 De bekwaamheidseisen Leraar Voorbereidend Hoger Onderwijs zijn, naast de voor alle wo-bacheloropleidingen geldende Dublin-descriptoren en algemene wettelijke eisen, richtinggevend voor de doelstellingen en eindtermen van de minor Educatie en Educatieve module. Deze bekwaamheidseisen zijn vastgelegd in de Wet op het voortgezet onderwijs (artikel 36 e.v.) en het Besluit bekwaamheidseisen onderwijspersoneel (zie Besluit bekwaamheidseisen onderwijspersoneel (http://wetten.overheid.nl/BWBR0018692/2017-08-01) en Besluit van 16 maart 2017 tot wijziging van het Besluit bekwaamheidseisen onderwijspersoneel en het Besluit bekwaamheidseisen

onderwijspersoneel BES in verband met de herijking van de bekwaamheidseisen voor leraren en docenten (https://zoek.officielebekendmakingen.nl/stb-2017-148.html). De eindtermen zijn toegespitst op de onderwijssector waarvoor de minor Educatie of Educatieve module opleidt en waarop de bevoegdheid die er sinds 2009 aan verbonden is betrekking heeft: de theoretische leerweg in het vmbo en de eerste drie klassen van havo en vwo.

De eindtermen zijn geordend in twee categorien:

a. Eindtermen 1, 2, 3:

deze hebben rechtstreeks te maken met de kern van het beroep: het onderwijsleerproces en het leren van leerlingen, te weten de vakinhoudelijke, vakdidactische en pedagogische bekwaamheid.

b. Eindtermen 4 en 5:

deze hebben betrekking op meer algemene aspecten van professioneel handelen ten dienste van die kern van het beroep: te weten samenwerking met collega's en de omgeving van de school en met reflectie en persoonlijke en professionele ontwikkeling.

De opleiding draagt er zorg voor dat de afgestudeerde Leraar VHO met een beperkte tweedegraads bevoegdheid in ieder geval:

1. aantoonbaar beschikt over vakinhoudelijke kennis en vaardigheden die verondersteld mogen worden op wo-bachelorniveau, en dus:

a. de inhoud van het schoolvak in de onderbouw beheerst;
b. daardoor de leerstof, voor het schooltype waarin de leraar werkzaam is, zo kan samenstellen, kiezen of bewerken dat de leerlingen die kunnen leren;
c. vanuit vakinhoudelijke expertise verbanden kan leggen met het dagelijks leven, en het onderwijs betekenisvol kan maken voor de leerlingen;
d. daarmee kan bijdragen aan de algemene vorming van de leerlingen

2. aantoonbaar beschikt over vakdidactische kennis en vaardigheden, en dus:

a. vakinhoud weet te vertalen in lessenreeksen en dat doet op een ontwikkelingsgerichte werkwijze;
b. vakinhoud leerbaar maakt voor de leerlingen, daarbij doelmatig gebruikmakend van (digitale) beschikbare leermiddelen;
c. het onderwijs kan ontwikkelen en evalueren;
d. het onderwijs doelmatig kan uitvoeren;
e. de vak inhoud/didactiek afstemt met collega's.

3. aantoonbaar beschikt over pedagogische kennis en vaardigheden, en dus

a. het handelen af kan stemmen op de leerlingen;
b. zicht heeft op de sociaal-emotionele en morele ontwikkeling van de leerlingen;
c. bijdraagt aan burgerschapsvorming;
d. in samenwerking met collega's een veilig, ondersteunend en stimulerend leerklimaat voor leerlingen kan realiseren;

4. aantoonbaar reflecteert ten behoeve van persoonlijke en professionele ontwikkeling, en dus:

a. in staat is kritisch te reflecteren op alle aspecten die met zijn/haar persoonlijkheid, motivatie, attitudes, verwachtingen en cognities te maken hebben (die onder meer tot uiting komen in het pedagogisch handelen) en feedback hieromtrent ter harte te nemen;
b. de (eigen) onderwijspraktijk verbetert en blijft ontwikkelen;
c. (vak)kennis en -kunde actueel kan houden;

5. aantoonbaar samenwerkt en communiceert met collega's en omgeving, en dus:

a. het pedagogisch handelen kan bespreken met collega's en met anderen die voor de ontwikkeling van de leerling verantwoordelijk zijn;
b. de ontwikkeling van het vak/curriculum in de school kan bespreken met collega's en met anderen die voor de ontwikkeling van de leerling verantwoordelijk zijn.