# Appendices: Bachelor's degree programme in Computing Science 2017-2018

## Appendix I Learning outcomes of the degree programme (Article 1.3.a)

Holders of a Bachelor's degree in Computing Science:

1. Have the following knowledge, understanding and insights on an academic level:
a. knowledge of the main topics of Computing Science;
b. understanding of common themes and principles of Computing Science on different levels of abstraction;
c. insight in the applicability of Computing Science and the interplay between theory and practice;
d. either d1: in-depth knowledge of certain topics in the field of Computing Science, or d2: broad-based knowledge of topics in a different discipline.

2. Have the following skills and competences, on an academic level:
a. technical skills associated with Computing Science, including relevant mathematical and logical skills;
b. relevant soft skills, including communication, intercultural teamwork and self-managed learning;
c. academic skills, including conceptual thinking, critical questioning, judgement forming, scientific research, writing and presenting in English;
d. the competence to analyse, structure, redefine and solve problems, using computational methods and tools;
e. the competence to design, develop and evaluate computer systems;
f. the competence to apply their knowledge and understanding of Computing Science in a globalized professional and entrepreneurial context.

3. Have the following attitudes:
a. appreciation of the role and importance of mathematics, related disciplines and domain-specific knowledge;
b. commitment to professional responsibility, including ethical, societal and intercultural issues, with a self-critical attitude;
c. critical and academic attitude towards information and knowledge;
d. preparedness to life-long learning, based on the awareness of the highly dynamical character of Computing Science.

## Appendix II Majors and Minors of the degree programme (Article 2.1.4)

The degree programme has one Major: Computing Science.

# Appendix III Course units in the propaedeutic phase

- **List of course units; Article 3.1.1**

| **Course unit name** | **ECTS** | **Type of examination** | **Practical** |
|---|---|---|---|
| Imperative Programming | 5 | p,e | x |
| Introduction to Computing Science | 5 | p,e | x |
| Introduction to Logic (CS & MA) | 5 | p,e | x |
| Discrete Structures | 5 | p,e | |
| Computer Architecture | 5 | p,e | x |
| Calculus for Computing Science | 5 | p,e | x |
| Algorithms and Data Structures in C | 5 | p,e | x |
| Introduction to Scientific Computing | 5 | p,e | x |
| Program Correctness | 5 | p,e | |
| Artificial Intelligence 1 | 5 | p,e | x |
| Object-Oriented Programming | 5 | p,e | x |
| Linear Algebra & Multivariable Calculus for AI&CS | 5 | p,e | |
| **Total** | **60** | | |

(p=practical and/or homework, e=examination, x=computer practical)

# Appendix IV Course units in the post-propaedeutic phase

- **List of course units; Article 6.1.1**

| **Course unit** | **ECTS** | **Type of examination** | **Practical** |
|---|---|---|---|
| Functional Programming | 5 | p,e | x |
| Advanced Object Oriented Programming | 5 | p | x |
| Statistics (AI and CS) | 5 | p,e | x |
| Problem Analysis and Software Design | 5 | p | x |
| Introduction to Information Systems | 5 | p,e | x |
| Signals and Systems | 5 | p,e | x |
| Advanced Algorithms and Data Structures | 5 | p,e | x |
| Software Engineering | 10 | p | x |
| Computing Science: Ethical and Professional Issues | 5 | p,e | x |
| Parallel Computing | 5 | p,e | x |
| Languages and Machines | 5 | p,e | |
| Minor (content determined by the student)<br>*Optional course units offered by Computing Science that may be used to fill (part of) the minor:*<br>- *Requirements Engineering and Software Startups*<br>- *Information Security*<br>- *Introduction to Intelligent Systems*<br>- *Software Quality Assurance and Testing*<br>- *Compiler Construction*<br>- *Short programming project* | 30<br><br><br><br>*5*<br>*5*<br>*5*<br>*5*<br>*5*<br>*5* | <br><br><br><br>*p,e*<br>*p,e*<br>*p,e*<br>*p*<br>*p,e*<br>*p* | <br><br><br><br>*x*<br>*x*<br>*x*<br>*x*<br>*x*<br>*x* |
| Net-Computing | 5 | p,e | |
| Computer Graphics | 5 | p,e | x |
| Operating Systems | 5 | p,e | x |
| Bachelor's project | 15 | thesis and colloquium | variable |
| **Total** | **120** | | |

(p=practical and/or homework, e=examination, x=computer practical)

- **Compulsory order of examinations; Article 8.2**

The examinations for the course units listed below may not be taken before the examinations for the associated course units have been passed:

- Signals and Systems after having passed Calculus for Computing Science and Linear Algebra & Multivariable Calculus for AI&CS.
- Bachelor's project after having completed the propaedeutic phase and earned 80 ECTS from years 2 and 3.

# Appendix V Entry requirements (Article 10.2.1)

### A. Deficient VWO-diploma

1. The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

| **Bacheloropleiding**<br><br>*Bachelor's degree programme* | **N+T** | **N+G** | **E+M** | **C+M** |
|---|---|---|---|---|
| **Biologie**<br><br>*Biology* | Biologie | Natuurkunde | Wiskunde A of B<br>Natuurkunde<br>Scheikunde<br>Biologie | Wiskunde A of B<br>Natuurkunde<br>Scheikunde<br>Biologie |
| **Farmacie**<br><br>*Pharmacy* | V | Natuurkunde | Natuurkunde<br>Scheikunde | Wiskunde A of B<br>Natuurkunde<br>Scheikunde |
| **Life Science and Technology**<br>**Scheikunde**<br>*Chemistry*<br>**Scheikundige Technologie**<br>*Chemical Engineering* | V | Wiskunde B<br>Natuurkunde | Wiskunde B<br>Natuurkunde<br>Scheikunde | Wiskunde B<br>Natuurkunde<br>Scheikunde |
| **Informatica**<br>*Computing Science*<br>**Technische Bedrijfskunde**<br>*Industrial Engineering and Management*<br>**(Technische) Wiskunde**<br>*(Applied) Mathematics* | V | Wiskunde B | Wiskunde B | Wiskunde B |
| **Kunstmatige Intelligentie**<br>*Artificial Intelligence* | V | V | V | Wiskunde A of B |
| **(Technische) Natuurkunde**<br>*(Applied) Physics*<br>**Sterrenkunde**<br>*Astronomy* | V | Wiskunde B<br>Natuurkunde | Wiskunde B<br>Natuurkunde | Wiskunde B<br>Natuurkunde |

2. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).
3. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

**B. HBO (university of applied science) propaedeutic certificate, other universities**

1. The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

| **Bachelor's degree programme** | **Subjects at VWO (pre-university) level** | Requirement: Dutch as a Second Language (programme II) for non-native speakers of Dutch |
|---|---|---|
| B Biology | wia or wib + na+sk+bio | Yes |
| B Pharmacy | wia or wib + na+sk | Yes |
| B Life Science and Technology | wib+na+sk | Yes |
| B Computing Science | wib | |
| B Artificial Intelligence | wia or wib | |
| B Physics | wib+na | |
| B Chemistry | wib+na+sk | |
| B Astronomy | wib+na | |
| B Mathematics | wib | |
| B Chemical Engineering | wib+na+sk | |
| B Industrial Engineering and Management Science | wib | |
| B Applied Physics | wib+na | |
| B Applied Mathematics | wib | |

wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology

2. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

3. In addition, candidates are required to be competent in English:

| | |
|---|---|
| IELTS (Academic) | 6.5 - no less than 6.0 on each section |
| TOEFL IBT (internet-based test) | 92 - no less than 21 on each section |
| TOEFL CBT (computer-based test) | 237 - no less than 21 on each section |
| TOEFL PBT (paper-based test) | 580 - no less than 55 on each section |
| Cambridge English | CAE or CPE Certificate |
| English language test - University of Groningen Language Centre | Minimum section scores C2 or C1 (one B2 allowed) |

4. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

## C. Foreign qualifications (EEA)

1. Any certificate that grants access to a university in a European country will also grant access to Dutch universities.

2. In the entrance examination, as referred to in art. 7.28, paragraph 3 of the Act, per country and educational institution specific training conditions are mentioned. These are standardized. The entrance examination is, in accordance with the Admissions Board Bachelor's programmes FSE, carried out by the Admissions Office. If for a specific diploma no standardisation has taken place then the requirements as formulated for candidates with a HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).

3. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

4. In addition, candidates are required to be competent in English:

| | |
|---|---|
| IELTS (Academic) | 6.5 - no less than 6.0 on each section |
| TOEFL IBT (internet-based test) | 92 - no less than 21 on each section |
| TOEFL CBT (computer-based test) | 237 - no less than 21 on each section |
| TOEFL PBT (paper-based test) | 580 - no less than 55 on each section |
| Cambridge English | CAE or CPE Certificate |
| English language test - University of Groningen Language Centre | Minimum section scores C2 or C1 (one B2 allowed) |

5. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

## D. Foreign qualifications (non-EEA)

1. A non-European certificate that according to NUFFIC and/or NARIC standards is equivalent to a Dutch VWO certificate will grant access to university in the Netherlands.

2. In the entrance examination, as referred to in art. 7.28, paragraph 3 of the Act, per country and educational institution specific training conditions are mentioned. These are standardized. The entrance examination is, in accordance with the Admissions Board Bachelor's programmes FSE, carried out by the Admissions Office. If for a specific diploma no standardisation has taken place then the requirements as formulated for candidates with a HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).

3. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

4. In addition, candidates are required to be competent in English:

| | |
|---|---|
| IELTS (Academic) | 6.5 - no less than 6.0 on each section |
| TOEFL IBT (internet-based test) | 92 - no less than 21 on each section |

| | |
|---|---|
| TOEFL CBT (computer-based test) | 237 - no less than 21 on each section |
| TOEFL PBT (paper-based test) | 580 - no less than 55 on each section |
| Cambridge English | CAE or CPE Certificate |
| English language test - University of Groningen Language Centre | Minimum section scores C2 or C1 (one B2 allowed) |

5. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

**E. Entrance examination (Colloquium Doctum)**

1. The following requirements apply to the entrance examination as defined in Article 7.29 of the Act:

| **Degree programme** | **Nature and Health VWO level** | **or** | **Nature and Technology VWO level** |
|---|---|---|---|
| B Biology | en, wia or b, sk, bio, na | | en, wib, na, sk, bio |
| B Pharmacy | en, wia or b, sk, bio, na | | en, wib, na, sk |
| B Life Science and Technology | en, wib, sk, bio, na | | en, wib, na, sk |
| B Computing Science | en, wib, sk, bio | | en, wib, na, sk |
| B Artificial Intelligence | en, wia or b, sk, bio | | en, wib, na, sk |
| B Physics | en, wib, sk, bio, na | | en, wib, na, sk |
| B Chemistry | en, wib, sk, bio, na | | en, wib, na, sk |
| B Astronomy | en, wib, sk, bio, na | | en, wib, na, sk |
| B Mathematics | en, wib, sk, bio | | en, wib, na, sk |
| B Chemical Engineering | en, wib, sk, bio, na | | en, wib, na, sk |
| B Industrial Engineering and Management Science | en, wib, sk, bio | | en, wib, na, sk |
| B Applied Physics | en, wib, sk, bio, na | | en, wib, na, sk |
| B Applied Mathematics | en, wib, sk, bio | | en, wib, na, sk |

en = English; wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology

2. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

3. In addition, candidates are required to be competent in English:

| | |
|---|---|
| IELTS (Academic) | 6.5 - no less than 6.0 on each section |
| TOEFL IBT (internet-based test) | 92 - no less than 21 on each section |
| TOEFL CBT (computer-based test) | 237 - no less than 21 on each section |
| TOEFL PBT (paper-based test) | 580 - no less than 55 on each section |
| Cambridge English | CAE or CPE Certificate |
| English language test - University of Groningen Language Centre | Minimum section scores C2 or C1 (one B2 allowed) |

4. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

# Appendix VII Admission to the post-propaedeutic phase (Article 5.1.1)

The following candidates will be admitted to the post-propaedeutic phase:
Students who have been issued a positive study advice from the degree programme in Computing Science

# Appendix VIII Contact hours propaedeutic phase (Article 2.4)

| **Bachelor year 1** | |
|---|---|
| *Type of contact* | *Number of contact hours per year* |
| Lectures | 280 |
| Tutorials | 216 |
| Practical | 112 |
| Study support/Mentor groups | – |
| Internship support and guidance | – |
| Exams | 43 |
| Misc. contact hours | – |

# Appendix IX University Minors of the faculty of Science and Engineering (Article 7.5.1)

1. Neurosciences Minor (taught in English):
   - Neuroscience (15 ECTS)
   - Behavioural Neuroscience (15 ECTS)

Minor Future Planet Innovation (taught in English):
- Global Challenges (10 ECTS)
- Sustainability in perspective (5 ECTS)
- Sustainable contributions to society(15 ECTS)

Astronomy through Space and Time Minor (taught in English):
- The Evolving Universe (5 ECTS)
- Cosmic Origins (5 ECTS)
- Astrobiology (5 ECTS)

Einstein's physics: Space-time and parallel worlds (taught in English):
- Einstein's Universe (5 ECTS)
- Quantum World (5 ECTS)
- Building blocks of matter (5 ECTS)

2. The Programme Committee for the Bachelor's degree programmes in Biology and Life Science & Technology also has authority in the field of the Minor "Neurosciences" and/or its course units.

The Programme Committee for the Master's degree programme in Energy & Environmental Sciences also has authority in the field of the Minor "Future Planet Innovation" and/or its course units.

The Programme Committee for the Bachelor's degree programme in Astronomy also has authority in the field of the Minor "Astronomy through Space and Time" and/or its course units.

The Programme Committee for the Bachelor's degree programmes in Physics and Applied Physics also has authority in the field of the Minor "Einstein's physics: Space-time and parallel worlds" and/or its course units.

3. The Board of Examiners for the Bachelor's degree programmes in Biology and Life Science & Technology and the Master's degree programmes in Biology, Ecology & Evolution, Marine Biology and Molecular Biology & Biotechnology also has authority in the field of the Neurosciences Minor and/or its course units.

The Board of Examiners for the Master's degree programme in Energy & Environmental Sciences also has authority in the field of the Future Planet Innovation Minor and/or its course units.

The Board of Examiners for the Bachelor's degree programme in Astronomy also has authority in the field of the Astronomy through Space and Time Minor and/or its course units.

The Board of Examiners for the Bachelor's degree programmes in Physics and Applied Physics also has authority in the field of the Physics Minor "Einstein's physics: Space-time and parallel worlds" and/or its course units.

4. These Teaching and Examination Regulations also apply in their entirety to the Minors in Neurosciences, Future Planet Innovation, Astronomy through Space and Time and Einstein's physics: Space-time and parallel worlds and/or their course units.

# Appendix X Transitional arrangement (article 12.1)

Transitional arrangement for the Bachelor's programme in Computing Science:

| **Discontinued course units** | | | | **Substitute course units** | | | | |
|---|---|---|---|---|---|---|---|---|
| *Course unit code* | *Course unit name* | *ECTS* | *Final exam period* | *Course unit code* | *Course unit name* | *ECTS* | *Note* | *Equivalent* Yes/No* |
| INBS E1-08 | Software Engineering I | 5 | April 2017 | WBCS17001 | Software Engineering | 10 | In consultation with the lecturer, part of the new course can be taken (i.e. if SE2 has been completed, but not SE1) | No, only the combination of SE1 and SE2 can substitute the new course |
| INBS E2-08 | Software Engineering II | 5 | June 2017 | WBCS17001 | Software Engineering | 10 | In consultation with the lecturer, part of the new course can be taken (i.e. if SE1 has been completed, but not SE2) | No, only the combination of SE1 and SE2 can substitute the new course |

* It is also possible to substitute equivalent course units in the other direction. This can apply to students with a large backlog who want to fall under the new TER.