Module Catalogue
for the Subject

Space Science and Technology
as a Master’s with 1 major
with the degree "Master of Science"
(120 ECTS credits)

Examination regulations version: 2012
Responsible: Institute of Computer Science
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Content and Objectives of the Programme

No translation available.
Abbreviations used

Course types: $E$ = field trip, $K$ = colloquium, $O$ = conversatorium, $P$ = placement/lab course, $R$ = project, $S$ = seminar, $T$ = tutorial, $Ü$ = exercise, $V$ = lecture

Term: $SS$ = summer semester, $WS$ = winter semester

Methods of grading: $NUM$ = numerical grade, $B/NB$ = (not) successfully completed

Regulations: $(L)ASPO$ = general academic and examination regulations (for teaching-degree programmes), $FSB$ = subject-specific provisions, $SFB$ = list of modules

Other: $A$ = thesis, $LV$ = course(s), $PL$ = assessment(s), $TN$ = participants, $VL$ = prerequisite(s)

Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

In accordance with

the general regulations governing the degree subject described in this module catalogue:

frei

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

10-Oct-2012 (2012-177)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.
Compulsory Courses

(56 ECTS credits)
Space Science
(30 ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
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<td>Space Physics (Introduction)</td>
<td>10-I=ISP-122-m01</td>
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**Contents**

1. Overview  
2. Dynamics of charged particles in magnetic and electric fields  
3. Elements of space plasma physics  
4. Sun and heliosphere  
5. Acceleration and transport of energetic particles in the heliosphere  
6. Instruments for measuring energetic particles in space.

**Intended learning outcomes**

The students possess a fundamental knowledge about space physics and, in particular, the description of the dynamics of charged particles in the heliosphere and in space. They are familiar with the relevant parameters, their theoretical formulation and the methods to measure them.

**Courses**

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**

written examination (approx. 60 to 90 minutes)  
Language of assessment: English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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### Contents
This course covers the area optics and radar-based observations. It is part of the international SpaceMaster and is taught at the Swedish partner university.

### Intended learning outcomes
The students master optical and radar-based observations.

### Courses
V + P + T (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
- written examination (approx. 60 to 90 minutes)
- Language of assessment: English

### Allocation of places
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### Additional information
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**Contents**

This course covers the area image processing and remote sensing (space physics). It is part of the international SpaceMaster and is taught at the Swedish partner university.

**Intended learning outcomes**

The students master image processing and remote sensing (space physics).

**Courses** (type, number of weekly contact hours, language — if other than German)

V + P + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — If not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 90 minutes)

Language of assessment: English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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### Contents

This course covers the area spacecraft environment interaction. It is part of the international SpaceMaster and is taught at the Swedish partner university.

### Intended learning outcomes

The students master optical and radar-based observations.

### Courses

V + P (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

written examination (approx. 60 to 90 minutes)

Language of assessment: English

### Allocation of places

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### Additional information

--

### Referred to in LPO I (examination regulations for teaching-degree programmes)

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Space Technology
(30 ECTS credits)
CanSat Design Workshop

**Abbreviation**
10-I=CSD-122-m01

**Module coordinator**
holder of the Chair of Computer Science VIII

**Module offered by**
Institute of Computer Science

**ECTS**
7

**Method of grading**
numerical grade

**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
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### Contents

CanSat (now known as FloatSat) is an interdisciplinary project designed - not only - for SpaceMaster students. It is designed for students with different backgrounds, e.g. in computer science, electronics, mechanical engineering, aerospace technology, physics, mathematics. A satellite project is an interdisciplinary project that requires knowledge and skills in this as well as in numerous other fields. CanSat is thus an ideal platform to combine all available skills in a single project. It covers the design and development of the space segment control software and the ground segment control software: telemetry and telecommanding in wireless communication: space segment - ground segment, electrical subsystem (energy, batteries), mechanical construction.

### Intended learning outcomes

The students are able to build and integrate into the inside of the sphere the power unit, a control computer, a payload (camera) and attitude control devices: Gyros and reaction wheel of a pico satellite. The software of a CanSat "satellite" includes a real-time operating system (provided by us), commanding (immediate and time-tagged commands), telemetry (real time and history data), attitude control, power control, payload control, image processing and radio links communication. The ground segment ought to be able to generate and send telecommands and to get and (graphically) display the telemetry.

### Courses

- **R** (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

- a) written examination (approx. 60 to 90 minutes) or b) project (approx. 20 pages) or c) oral examination of one candidate each or oral examination in groups (15 to 30 minutes per candidate)

Language of assessment: English

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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## Module title

**Spacecraft System Design**

### Abbreviation

10-I=SSD-122-m01

### Module coordinator

holder of the Chair of Computer Science VII

### Module offered by

Institute of Computer Science

### ECTS

8

### Method of grading

numerical grade

### Only after succ. compl. of module(s)

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### Duration

1 semester

### Module level

graduate

### Other prerequisites

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## Contents


## Intended learning outcomes

The students master system aspects of the layouting of technical systems. Using the example of spacecraft, major subsystems and their integration into a working whole are being analysed.

## Courses

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## Method of assessment

written examination (approx. 60 to 90 minutes)

Language of assessment: English

## Allocation of places

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## Additional information

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## Referred to in LPO I

(examination regulations for teaching-degree programmes)

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**Contents**

Fundamental principles of astrodynamics, orientation control of satellites, sensors, actuators, control software, example realisations, spin-stabilised satellites, 3-axis stabilised satellites.

**Intended learning outcomes**

The students master the fundamentals of dynamic aspects of the design of spacecraft and are familiar with the essential sensors and actuators as well as their areas of use in spaceflight.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — If not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Contents**

This course covers the area electronics in space. It is part of the international SpaceMaster and is taught at the Swedish partner university.

**Intended learning outcomes**

The students master electronics in space.

**Courses**

V + P (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**

- written examination (approx. 60 to 90 minutes)
- Language of assessment: English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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Compulsory Electives

(34 ECTS credits)
Space Robotics and Control
(30 ECTS credits)
**Module title** | **Abbreviation**  
--- | ---  
Team Design Project | 10-I=TDP-122-m01  

**Module coordinator**  
holder of the Chair of Computer Science VII  

**Module offered by**  
Institute of Computer Science  

**ECTS** | **Method of grading** | **Only after succ. compl. of module(s)**  
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9 | numerical grade | --  

**Duration** | **Module level** | **Other prerequisites**  
1 semester | graduate | --  

**Contents**  
Multi-disciplinary project in the area of aerospace that covers areas such as mechanical components, electronics and software. In this context, current and relevant topics from research are reviewed.

**Intended learning outcomes**  
Students will practise reviewing complex topics in interdisciplinary teams. They will be required to plan, execute and check their work. At the end of the course, they will have created a completely functional system.

**Courses** (type, number of weekly contact hours, language — if other than German)  
R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)  
a) written examination (approx. 60 to 90 minutes) or b) project (approx. 20 pages) or c) oral examination of one candidate each or oral examination in groups (15 to 30 minutes per candidate)  
Language of assessment: English

**Allocation of places**  
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**Additional information**  
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**Module coordinator**
holder of the Chair of Computer Science VII

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
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**Contents**
Advanced topics in automation systems as well as instrumentation and control engineering, for example from the field of sensor data processing, actuators, cooperating systems, mission and trajectory planning.

**Intended learning outcomes**
The students have an advanced knowledge of selected topics in automation systems. They are able to implement advanced automation systems.

**Courses**
V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**
written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**
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**Additional information**
--

**Referred to in LPO I** (examination regulations for teaching-degree programmes)
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### Module title
Robotics 1

### Abbreviation
10-I=RO1-122-m01

### Module coordinator
holder of the Chair of Computer Science VII

### Module offered by
Institute of Computer Science

### ECTS
8

### Method of grading
Only after succ. compl. of module(s)

### Numerical grade
--

### Duration
1 semester

### Module level
graduate

### Other prerequisites
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### Contents
- History, applications and properties of robots, direct kinematics of manipulators: coordinate systems, rotations, homogenous coordinates, axis coordinates, arm equation.
- Inverse kinematics: solution properties, end effector configuration, numerical and analytical approaches, examples of different robots for analytical approaches.
- Workspace analysis and trajectory planning, dynamics of manipulators: Lagrange-Euler model, direct and inverse dynamics.
- Mobile robots: direct and inverse kinematics, propulsion system, tricycle, Ackermann steering, holonomes and non-holonom restrictions, kinematic classification of mobile robots, posture kinematic model.
- Movement control and path planning: roadmap methods, cell decomposition methods, potential field methods.
- Sensors: position sensors, speed sensors, distance sensors.

### Intended learning outcomes
The students master the fundamentals of robot manipulators and vehicles and are, in particular, familiar with their kinematics and dynamics as well as the planning of paths and task execution.

### Courses
V + T (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
- written examination (approx. 60 to 90 minutes)
- Language of assessment: English

### Allocation of places
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### Additional information
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holder of the Chair of Computer Science VII

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
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**Contents**
Foundations of dynamic systems, controllability and observability, controller design through pole assignment: feedback and feed-forward, state observer, feedback with state observer, time discrete systems, stochastic systems: foundations of stochastics, random processes, stochastic dynamic systems, Kalman filter: derivation, initialising, application examples, problems of Kalman filters, extended Kalman filter.

**Intended learning outcomes**
The students master all fundamentals that are necessary to understand Kalman filters and their use in applications of robotics. The students possess a knowledge of advanced controller and observer methods and recognise the connections between the dual pairs controllability - observability as well as controller design and observer design. They also recognise the relationship between the Kalman filter as a state estimator and an observer.

**Courses**
V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**
written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**
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**Contents**

Current topics in the area of aerospace.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge about advanced topics in software engineering with a focus on modern software architectures and fundamental approaches to model-driven software engineering.

**Courses**

(type, number of weekly contact hours, language — if other than German)

S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**

(type, scope, language — if other than German, examination offered — If not every semester, information on whether module is creditable for bonus)

Seminar paper (approx. 20 pages)
Language of assessment: English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**
(examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Computer and Communication Networks</td>
<td>10-I=CCN-122-m01</td>
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<th>Module coordinator</th>
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<tbody>
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**Contents**

This course covers the area computer and communication networks. It is part of the international SpaceMaster and is taught at the Swedish partner university.

**Intended learning outcomes**

The students master computer and communication networks.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<table>
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**Contents**

This course covers the area telecommunication in space. It is part of the international SpaceMaster and is taught at the Swedish partner university.

**Intended learning outcomes**

The students master optical and radar-based observations.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**

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**Additional information**

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<table>
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**Contents**

In the form of a group project, this course covers a special topic of the SpaceMaster programme. The course is part of the international SpaceMaster and is taught at the Swedish partner university.

**Intended learning outcomes**

The students master a practical task of the SpaceMaster.

**Courses**

S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**

(project (approx. 20 pages))

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)
Space Technology

(4 ECTS credits)
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<td>Java Programming</td>
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**Module coordinator**

holder of the Chair of Computer Science II

**Module offered by**

Institute of Computer Science

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**Duration**

1 semester

**Module level**

graduate

**Other prerequisites**

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**Contents**

This module introduces students to the object-oriented programming language Java - not from a theoretical point of view but in a practice-oriented manner with the help of numerous examples and training exercises. The module includes detailed presentations of all parts of the programming language Java as well as the respective ways to use these.

**Intended learning outcomes**

The students are familiar with the basics of the programming language Java and are able to independently develop small applications.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 90 minutes) or oral examination of one candidate each or oral examination in groups (15 minutes per candidate)

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<td>Internet Technologies</td>
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**Contents**

Structure and basic mechanisms of TCP/IP, internet routing, IP network management, wireless access, e.g. 3rd generation mobile networks, GSM technologies.

**Intended learning outcomes**

The students master the fundamentals of the structure, architecture and technology of the internet.

**Courses**

(No information on SWS (weekly contact hours) and course language available)

**Method of assessment**

(A no information on SWS (weekly contact hours) and course language available)

Written examination (approx. 60 to 90 minutes) or oral examination of one candidate each or oral examination in groups (15 minutes per candidate)

**Allocation of places**

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**Module coordinator**

Dean of Studies Informatik (Computer Science)  
Institute of Computer Science

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**Contents**

Data warehouses and data mining; web databases; introduction to Datalog.

**Intended learning outcomes**

The students have advanced knowledge about relational databases, XML and data mining.

**Courses**

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**

written examination (approx. 60 to 90 minutes) or oral examination of one candidate each or oral examination in groups (15 minutes per candidate)

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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Thesis
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**Contents**

Researching and writing on a complex problem in the area of space science and technology within a given time frame and adhering to the principles of good scientific practice.

**Intended learning outcomes**

Researching and writing on a complex problem in the area of space science and technology within a given time frame and adhering to the principles of good scientific practice.

**Courses** (type, number of weekly contact hours, language — if other than German)

no courses assigned

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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