Module Catalogue
for the Subject
Aerospace Computer Science
as a Master’s with 1 major
with the degree "Master of Science"
(120 ECTS credits)

Examination regulations version: 2021
Responsible: Institute of Computer Science
# Contents

The subject is divided into 4

## Content and Objectives of the Programme

## Abbreviations used, Conventions, Notes, In accordance with

## Electives Field

## Seminars

- Seminar 1 · Current Topics in Aerospace Computer Science
- Seminar 2 · Current Topics in Aerospace Computer Science

## Aerospace Computer Science

- Spacecraft System Analysis
- Spacecraft Propulsion
- Orbital Mechanics
- Space Dynamics
- Advanced Sensory Systems and Sensor Data Processing
- Interplanetary Trajectories
- Flugzeugavionik
- Selected Topics in Aerospace Computing

## Robotics and Telematics

- Robotics 1
- Robotics 2
- Autonomous Mobile Systems
- 3D Point Cloud Processing
- Telecommunication Systems
- Selected Topics in Robotics and Telematics
- Radar Remote Sensing
- RF & Microwave Systems

## Practica Aerospace Computer Science

- Space Systems Design
- Design of Planetary Bases and Orbital Stations
- Practical course - Rocket Engineering and Payloads
- Aircraft Construction
- Flight Simulator
- Practical Telematics
- Team Design Project
- FloatSat Design Lab
- Telecommunication Systems Lab
- Radar Systems Lab

## Computer Science

- Computational Geometry
- Databases 2
- Advanced Data Science
- Advanced Programming
- Security of Software Systems
- Algorithms for Geographic Information Systems
- Multimodal User Interfaces
- Embedded Systems
- Artificial Intelligence 1
- Artificial Intelligence 2
- Performance Evaluation of Distributed Systems
- Systems Benchmarking
- Discrete Event Simulation
- Selected Topics in Algorithms
- Selected Topics in Theory
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<td>Master Project Modules</td>
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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:

**ASPO2015**

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

**28-Apr-2021 (2021-44)**

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.
Electives Field
(90 ECTS credits)
Seminars
(min. 5 ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
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<td>Seminar 1 - Current Topics in Aerospace Computer Science</td>
<td>10-LuRI=SEM1-202-m01</td>
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<th>ECTS</th>
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<td>1 semester</td>
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**Contents**

Independent review of a current topic in aerospace engineering on the basis of literature and, where applicable, software with written and oral presentation. The topics in modules 10-LURI-SEM1 and 10-LURI-SEM2 must come from different areas (this usually means that they are assigned by different lecturers).

**Intended learning outcomes**

The students are able to independently review a current topic in aerospace engineering, to summarise the main aspects in written form and to orally present these in an appropriate way.

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

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<th>S (2)</th>
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**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Term paper (10 to 15 pages) and presentation (30 to 45 minutes) with subsequent discussion on the topic of the seminar

Language of assessment: German and/or 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**

Independent review of a current topic in aerospace engineering on the basis of literature and, where applicable, software with written and oral presentation. The topics in modules 10-LURI-SEM1 and 10-LURI-SEM2 must come from different areas (this usually means that they are assigned by different lecturers).

**Intended learning outcomes**

The students are able to independently review a current topic in aerospace engineering, to summarise the main aspects in written form and to orally present these in an appropriate way.

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

| S (2) |

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

- term paper (10 to 15 pages) and presentation (30 to 45 minutes) with subsequent discussion on the topic of the seminar
- Language of assessment: German and/or 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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Aerospace Computer Science
(min. 20 ECTS credits)
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**Contents**

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**Intended learning outcomes**

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

V (4) + Ü (2)
Module taught in: English

**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 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: English
creditable for bonus

**Allocation of places**

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**Additional information**

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

--
Module title | Abbreviation
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Spacecraft Propulsion | 10-LURI=SP-202-m01

Module coordinator | Module offered by
--- | ---
-- | Institute of Computer Science

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

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

Contents
Basic functionalities and basic elements of the operation of air and space vehicles, ground station, structure of control centres, communication methods and systems, transmission path balance, transmission and operating standards, planning systems, operating procedures, flight manuals, telemetry and telecommando systems.

Intended learning outcomes
The students possess the theoretical and practical knowledge necessary to correctly classify systems to operate systems in air and space vehicles, identify the most important system relationships, formulate requirements for new systems and develop the complete system as well as individual system elements for the operation of air and space vehicles in the ground segment.

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

V (2) + Ü (2)

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 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

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
Orbital Mechanics

## Abbreviation
10-LURI=GRFM-212-m01

## Module coordinator
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## Module offered by
Institute of Computer Science

## ECTS
10

## Method of grading
numerical grade

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

## Duration
1 semester

## Module level
graduate

## Other prerequisites
--

### Contents
Foundations of orbital dynamics and orientation dynamics of air and space vehicles, spherical trigonometry, two-body problem, identification of classical orbit elements from initial conditions, identification of orbit elements through observation (Laplace method), identification of orientation data, rocket lift-off trajectory.

### Intended learning outcomes
Understanding of fundamental methods for acquisition, processing and control of orbit and orientation systems in air and space travel. Skills to apply the acquired knowledge in development and analysis of orbit and orientation systems.

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

V (4) + Ü (2)

### 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 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

or b) project (report (approx. 20 pages) with presentation (30 to 45 minutes) and subsequent discussion on the topic)
Language of assessment: German and/or English creditable for bonus

### 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 (2) + Ü (2)

Module taught in: English

**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. 90 to 120 minutes)

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: English

Creditable for bonus

**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
Advanced Sensory Systems and Sensor Data Processing

### Abbreviation
10-LURI=ASS-202-m01

### Module coordinator
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### Module offered by
Institute of Computer Science

### ECTS
5

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

### Numerical grade
--

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
Advanced automation systems need instrumentation concepts with proprioceptive and exteroceptive sensors. The sensors can be active or passive and may be enclosed into an embedded system. Only complex sensor systems and clever sensor data processing procedures ensure the tasks of satellite systems are performed in a reliable fashion. After discussing in detail state-of-the-art sensors and sensor systems, the course focuses on sensor data processing for in orbit and for planetary applications.

### Intended learning outcomes
Students will master modern sensor data acquisition systems with embedded processing and several advanced data processing concepts, like sensor data interpretation. Advanced state estimation methods will be discussed within localization and mapping and students will have to deal with linear, non-linear filters (Kalman Filter, Extended Kalman Filter, Unscented Kalman Filter, Particle Filter, etc.). Furthermore, students should be able to put novel research strands in this area like machine learning concepts into a scientific and technological perspective and should be aware about the advantages and disadvantages.

### Courses
- (type, number of weekly contact hours, language — if other than German)
  - V (2) + Ü (2)
  - Module taught in: German and/or English

### 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. 90 to 120 minutes)
  - If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
  - Language of assessment: German and/or English creditable for bonus

### Allocation of places
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### Additional information
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### Referred to in LPO I
(examination regulations for teaching-degree programmes)
--
Module title | Interplanetary Trajectories
---|---
Abbreviation | 10-LURI=LPT-202-m01

Module coordinator | --
Module offered by | Institute of Computer Science

ECTS | 5
Method of grading | numerical grade
Duration | 1 semester
Module level | graduate
Other prerequisites | --

Contents
---
Aircraft trajectory optimization belongs to the mathematical field of optimal control. This means that the optimal control history and the optimal state history (and maybe other additional parameters) that minimize a given cost function for a given dynamic system need to be calculated. Thereby, all given initial and final boundary conditions as well as path equality and inequality constraints need to be fulfilled. This enables e.g. the calculation of noise minimal approach and departure trajectories for a given aircraft at a given airport considering the population distribution as well as any procedural requirements.

Intended learning outcomes
---
In this lecture the students should learn how to solve such optimal control problems beginning with the modeling of the required dynamic system as well as the cost and constraint functions. In the next steps on the one side theoretical optimality conditions are derived for simple examples and on the other side discretization techniques for the solution of realistic problems are introduced. Afterwards, methods for the solution of the resulting sparse parameter optimization problem are presented. Finally, other aspects related to the implementation are introduced.

Courses (type, number of weekly contact hours, language — if other than German)
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V (2) + Ü (2)
Module taught in: English

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. 90 to 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: English
creditable for bonus

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**

The course *Avionik-Systeme (Avionics Systems)* offers an overview of software, hardware, sensors, actuators and communication of airplanes and satellites: 1. software module and the software structure 2. control 3. ground control, 4. sensors and actuators, 5. sensor fusion, 6. reliability

**Intended learning outcomes**

At the end of the course, the students should be familiar with typical structures of avionic systems for satellites and airplanes. They should be able to design these. They should be able to program simple controls.

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

V (2) + Ü (2)

**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 120 minutes)

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

--

**Additional information**

--

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

--
### Module Title

**Selected Topics in Aerospace Computing**

### Abbreviation

10-LURI=SLR-202-m01

### Module Coordinator

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### Module Offered by

Institute of Computer Science

### ECTS

5

### Method of Grading

Numerical grade

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

--

### Duration

1 semester

### Module Level

Graduate

### Other Prerequisites

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### Contents

Selected topics in aerospace engineering.

### Intended Learning Outcomes

The students understand the basic approach of aerospace engineering. They are able to understand the solutions of complex problems in this area and apply them to similar questions.

### Courses

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

V (2) + Ü (2)

### 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) with presentation (30 to 45 minutes) and subsequent discussion on the topic or
- c) oral examination of one candidate each (approx. 20 minutes) or
- d) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate)

Language of assessment: German and/or 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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Robotics and Telematics
(min. 20 ECTS credits)
### Module title
Robotics 1

### Abbreviation
10-LURI=RO1-202-m01

### Module coordinator
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### Module offered by
Institute of Computer Science

### ECTS
8

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### 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-holomone 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 (4) + Ü (2)

### Module taught in:
German and/or English

### Method of assessment
- written examination (approx. 60 to 90 minutes)
- If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or 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
Robotics 2

### Abbreviation
10-LURI=RO2-202-m01

### Module coordinator
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### Module offered by
Institute of Computer Science

### ECTS
8

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

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

V (4) + Ü (2)

Module taught in: German and/or English

### 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)

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

### 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>
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<th>Module title</th>
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<tbody>
<tr>
<td>Autonomous Mobile Systems</td>
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**Module coordinator**
Dean of Studies Informatik (Computer Science)

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
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**Contents**
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**Intended learning outcomes**
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**Courses** (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Module taught in: German and/or English

**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 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English
Creditable for bonus

**Allocation of places**
--

**Additional information**
--

**Referred to in LPO I** (examination regulations for teaching-degree programmes)
--
Module title | Abbreviation
---|---
3D Point Cloud Processing | 10-LURI=3D-202-m01

Module coordinator | Module offered by
holder of the Chair of Computer Science VII | Institute of Computer Science

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<th>Module level</th>
<th>Other prerequisites</th>
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<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

Contents
Laser scanning, Kinect and camera models, basic data structures (lists, arrays, octrees), calculating normals, kd-trees, registration, features, segmentation, tracking, applications for airborne mapping, applications to mobile mapping.

Intended learning outcomes
Students understand the fundamental principles of all aspects of 3D point cloud processing and are able to communicate with engineers / surveyors / CV people / etc. Students are able to solve problems of modern sensor data processing and have experienced that real application scenarios are challenging in terms of computational requirements, in terms of memory requirements and in terms of implementation issues.

Courses (type, number of weekly contact hours, language — if other than German)
V (2) + Ü (2)
Module taught in: German and/or English

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 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

Allocation of places
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Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
--
### Module title
Telecommunication Systems

### Abbreviation
10-I=TSD-212-m01

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

### Module offered by
Institute of Computer Science

### ECTS
10

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
The guidance and control of spacecraft depend on reliable communication. Scientific data returned to earth are irreplaceable, or replaceable only at the cost of another mission. In deep space, communications propagation is good, relative to terrestrial communications, and there is an opportunity to press toward the mathematical limit of microwave communication with reliability as well as channel capacity in mind. Further, the effects of small changes in the earth's atmosphere and the interplanetary plasma have small but important effects on propagation time and hence on the measurement of distance. This course presents a top-down approach to communications system design. The course will cover communication theory, algorithms and implementation architectures for essential blocks in modern physical-layer communication systems (antenna, coders and decoders, filters, multi-tone modulation, synchronization sub-systems).

### Intended learning outcomes
At the end of the course, students will have gone through the complete process of designing a telecommunication system for a spacecraft including the subsystems described in the table of contents. All systems involved in end-to-end telecommunication chain including principal components for implementation will be discussed during the course.

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

- V (4) + Ü (2)

Module taught in: English

### 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. 90 to 120 minutes)

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

creditable for bonus

Language of assessment: English

### Allocation of places
--

### Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):

- LR

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

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<table>
<thead>
<tr>
<th>Module title</th>
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<tr>
<td>Selected Topics in Robotics and Telematics</td>
<td>10-LURI=SRT-202-m01</td>
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<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

**Contents**

Selected topics in robotics and telematics

**Intended learning outcomes**

The students understand the basic approach of robotics and telematics. They are able to understand the solutions of complex problems in this area and apply them to similar questions.

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

V (2) + Ü (2)

**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) practical project (project documentation (approx. 20 pages) with presentation (30 to 45 minutes) and subsequent discussion on the topic) or  
c) oral examination of one candidate each (approx. 20 minutes) or  
d) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate)

Language of assessment: German and/or English creditable for bonus

**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>Radar Remote Sensing</td>
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<td>holder of the Chair of Computer Science IX</td>
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<th>Courses (type, number of weekly contact hours, language — if other than German)</th>
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<td>examination in groups of 2 candidates (approx. 15 minutes per candidate). Creditable for bonus. Language of</td>
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<td>Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits): LR</td>
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</tr>
<tr>
<td>Module title</td>
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<td>RF &amp; Microwave Systems</td>
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<tr>
<td>V (2) + Ü (2)</td>
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Module taught in: German and/or English

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<tr>
<th>Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)</th>
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Language of assessment: German and/or English
Creditable for bonus

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Practica Aerospace Computer Science
(min. 20 ECTS credits)
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<tr>
<td>Space Systems Design</td>
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**Module coordinator**

**Module offered by**

Institute of Computer Science

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**Duration**

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<tbody>
<tr>
<td>1 semester</td>
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**Contents**

In the course of a semesterproject, a spacecraft system will be designed in a team. The selection of the spacecraft system is done anew each semester and draws inspiration from current trends and concrete research, often from the area of microsatellites, like "design of a nanosatellite mission for detection and observation of transient lunar phenomenons (TLP)".

**Intended learning outcomes**

The students gain fundamental knowledge about the design of spacecraft systems. They are able to analyse the elementary design aspects, create requirements accordingly and consider them in their system design. With the help of the acquired knowledge of methods they are able to create dedicated tools and methods to support the design in the area of spacecraft systems. Also projectmanagement for the development of spacecraft systems will be trained.

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

R (6)

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

project report (10 to 15 pages) and presentation of project (15 to 30 minutes)

Language of assessment: German and/or English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

**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 Catalogue for the Subject Aerospace Computer Science

**Master's with 1 major, 120 ECTS credits**

<table>
<thead>
<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Design of Planetary Bases and Orbital Stations</td>
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<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
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</table>

### Contents

In light of future human settlements across the solar system, this lecture will focus on the special aspects of planning of planetary bases. This will train the planning of a very complex spacecraft apart from its individual components like satellites. The content will be decided upon each semester (for example lunar base, mars base etc) The most important aspects like motivation, goals, prerequisites, constraints, environment, localization, construction and operation scenarios, planning of modules and structures, lifesupport, energy, communication, production, transport between earth and moon as well as mobility on the surface of the moon will be conceptually layed out and analyzed.

### Intended learning outcomes

The students gain fundamental knowledge about the planning of planetary bases and orbital bases. They are able to analyse the elementary aspects of planning, pose requirements and consider the system design. With the support of the acquired knowledge of methods they are able to create dedicated tools and processes to support the planning in the area of planetary bases and orbital stations. Also projectmanagement for the development of planetary bases and orbital stations will be trained.

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

<table>
<thead>
<tr>
<th>Type</th>
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### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

- project report (10 to 15 pages) and presentation of project (15 to 30 minutes)

Language of assessment: German and/or English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

### 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
Practical course - Rocket Engineering and Payloads

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<th>Duration</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

| Contents |
In this internship, students are supposed to acquire practical experience in the design, building, execution and analysis of rocket experiments (including their payload). The goal is the design, building and testing of rocket experiments and their payloads.

| Intended learning outcomes |
The students gain fundamental knowledge about the design of spacecraft experiments, fundamental knowledge about rocket science, including launch preparations as well as the execution. They are able to analyse the elementary design aspects of rocket payloads, pose according requirements and respects those in the design. With the aid of the acquired methodic knowledge, they are able to apply dedicated tools and method in bigger projects.

| Courses (type, number of weekly contact hours, language — if other than German) |
P (6) |

| Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus) |
Report on practical course (4 to 5 pages) and presentation of results (15 to 30 minutes) |
Language of assessment: German and/or 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 Catalogue for the Subject
### Aerospace Computer Science
#### Master's with 1 major, 120 ECTS credits

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<thead>
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<th>Module title</th>
<th>Abbreviation</th>
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<td>Aircraft Construction</td>
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<tbody>
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<td>2 semester</td>
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### Contents
German contents available but not translated yet.

- Aufbau eines RV12 Kleinflugzeug
- Elemente des RV12 (Aluminiumverarbeitung)
- Aufbau eines Projektteams
- Aufgaben und Verantwortungsverteilung
- Qualitätssicherung
- Dokumentation der Arbeiten
- Bauen einiger Elemente des RV12
- Marketing und PR Aktivitäten

### Intended learning outcomes
German intended learning outcomes available but not translated yet.


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

R (6)

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

Report on practical course (10 to 15 pages) and presentation of results (15 to 30 minutes)
Language of assessment: German and/or English
creditable for bonus

### 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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<td>Flight Simulator</td>
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</thead>
<tbody>
<tr>
<td>2 semester</td>
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</table>

### Contents

- Layout of A320 cockpit, instruments in a A320 cockpit, flight preparations, cold and dark start of an A320, flight route entry, flight execution, taxing, take-off, flight, landing, taxing, anomalies and emergencies

### Intended learning outcomes

The students possess the technical, theoretical and practical knowledge and skills to do a flight with an A320. Important: this is no licence to fly and it’s not a pilot training.

### Courses

- R (6)

### Method of assessment

- Report on practical course (10 to 15 pages) and presentation of results (15 to 30 minutes)
- Language of assessment: German and/or English
- Creditable for bonus

### Allocation of places

- --

### Additional information

- --

### Referred to in LPO I

- (examination regulations for teaching-degree programmes)
## Module title
Practical Telematics

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>10-LURI=PTEL-202-m01</th>
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### Module coordinator
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### Module offered by
Institute of Computer Science

### ECTS
- **10**

### Method of grading
- **Numerical grade**

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

### Duration
- **1 semester**

### Module level
- **Graduate**

### Other prerequisites
--

## Contents
In this internship, students develop interdisciplinary solutions from the fields telecommunication, automation and computer science. The great advancements in the fields of telecommunication and information processing allow to offer ever more sophisticated services over long distances. By combining these disciplines with control and automation techniques in the field of telematics, new possibilities arise to acquire data remotely from a distance and to react accordingly. Possible focus topics: - automation, industry 4.0 - mobile systems, sensor data processing - space flight

## Intended learning outcomes
In this internship, students gather and deepen their skills in developing telecommunication solutions for automation systems or mobile robots. They learn acquiring fitting sensor data and evaluate it online (in realtime) and react with actions accordingly. They learn programming close to the hardware and master common libraries, for example the Robot Operating System (ROS).

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

- **P (6)**

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

Report on practical course (approx. 20 pages) with presentation (30 to 45 minutes) and subsequent discussion on the topic

Language of assessment: German and/or English

## Allocation of places
--

## Additional information
--

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

--
Module Catalogue for the Subject
Aerospace Computer Science
Master's with 1 major, 120 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
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<tr>
<td>Team Design Project</td>
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<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

### 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

R (8)
Module taught in: English

### Method of assessment

Practical project (project documentation (approx. 20 pages) with presentation (30 to 45 minutes) and subsequent discussion on the topic)
Language of assessment: English

### Allocation of places

--

### Additional information

--

### Referred to in LPO I

(examination regulations for teaching-degree programmes)

--
### FloatSat Design Lab

<table>
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### Contents

CanSat (now known as FloatSat) is an interdisciplinary project designed - not only - for Aerospace Engineering Master 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 (8)**
  - Module taught in: English

### Method of assessment

- **Practical project: development, construction and presentation of a satellite control system (project documentation (approx. 20 pages) with presentation (30 to 45 minutes) and subsequent discussion on the topic)**
  - 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**

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**Intended learning outcomes**

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**Courses**

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

V (2) + P (4)

Module taught in: English

**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. 20 minutes) or
b) oral group examination (max. 3 candidates, approx. 15 minutes each) or
c) report (4-8 pages)

Language of assessment: English

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):

LR

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
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**Other prerequisites**
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**Contents**
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**Intended learning outcomes**
--

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

V (2) + P (4)

Module taught in: English

**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. 90 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate) or report (4-8 pages)
Language of assessment: German and/or English

**Allocation of places**
--

**Additional information**

Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits):
SEC

**Referred to in LPO I** (examination regulations for teaching-degree programmes)
--
Computer Science
(min. 15 ECTS credits)
**Module title**  
Computational Geometry

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

**Module offered by**  
Institute of Computer Science

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<td>1 semester</td>
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</table>

**Contents**

In many areas of computer science -- for example robotics, computer graphics, virtual reality and geographic information systems -- it is necessary to store, analyse, create or manipulate spatial data. This class is about the algorithmic aspects of these tasks: We will acquire techniques that are needed to plan and analyse geometric algorithms and data structures. Every technique will be illustrated with a problem in the practical areas listed above.

**Intended learning outcomes**

The students are able to decide which algorithms or data structures are suitable for the solution of a given geometric problem. The students are able to analyse new problems and to come up with their own efficient solutions based on the concepts and techniques acquired in the lecture.

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

V (2) + Ü (2)

**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 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

**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 coordinator**  
holder of the Chair of Computer Science IX

**Module offered by**  
Institute of Computer Science

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**Duration**  
1 semester  

**Module level**  
graduate  

**Other prerequisites**  
--

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

V (2) + Ü (2)

**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 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

creditable for bonus  
Language of assessment: German and/or English

**Allocation of places**  
--

**Additional information**
Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):
SE, KI, HCI

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

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<table>
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<td>Advanced Data Science</td>
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**Contents**

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**Intended learning outcomes**

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

V (2) + U (2)

**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 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

**Allocation of places**

--

**Additional information**

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

--
# Module Catalogue for the Subject Aerospace Computer Science

**Master's with 1 major, 120 ECTS credits**

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<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Advanced Programming</td>
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**Module coordinator**
holder of the Chair of Computer Science IX

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

## Contents

With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and code a sensible structure. Also, further topics in the areas of software security and parallel programming are discussed.

## Intended learning outcomes

Students learn advanced programming paradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing concepts are introduced culminating in the use of GPU architectures for extremely quick processing.

## Courses

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

| V (2) + Ü (2) |

## 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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

creditable for bonus

Language of assessment: German and/or English

## Allocation of places

--

## Additional information

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):
SE,KI,LR, HCI, ES,GE,SEC

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

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<table>
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<td>Security of Software Systems</td>
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### Contents

The lecture provides an overview of common software vulnerabilities, state-of-the-art attack techniques on modern computer systems, as well as the measures implemented to protect against these attacks. In the course, the following topics are discussed:

- x86-64 instruction set architecture and assembly language
- Runtime attacks (code injection, code reuse, defenses)
- Web security
- Blockchains and smart contracts
- Side-channel attacks
- Hardware security

### Intended learning outcomes

Students gain a deep understanding of software security, from hardware and low-level attacks to modern concepts such as blockchains. The lecture prepares for research in the area of security and privacy, while the exercises allow students to gain hands-on experience with attacks and analysis of systems from an attacker’s perspective.

### Courses

(V (2) + Ü (2))

Module taught in: English

### Method of assessment

Written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

### Allocation of places

--

### Additional information

Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits):

SE, KI, LR, HCI, ES, SEC

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

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<table>
<thead>
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<td>Algorithms for Geographic Information Systems</td>
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**Contents**

Algorithmic foundations of geographic information systems and their application in selected problems of acquisition, processing, analysis and presentation of spatial information. Processes of discrete and continuous optimisation. Applications such as the creation of digital height models, working with GPS trajectories, tasks of spatial planning as well as cartographic generalisation.

**Intended learning outcomes**

The students are able to formalise algorithmic problems in the field of geographic information systems as well as to select and improve suitable approaches to solving these problems.

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

V (2) + Ü (2)

**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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):

AT, KI, HCI, LR

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

--
### Module title

Multimodal User Interfaces

### Abbreviation

10-HCI=MMUI-161-m01

### Module coordinator

holder of the Chair of Computer Science IX

### Module offered by

Institute of Computer Science

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### Duration

1 semester

### Mode of grading

graduate

### Other prerequisites

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### Contents

The multimodal interaction paradigm simultaneously uses various modalities like speech, gesture, touch, or gaze, to communicate with computers and machines. Basically, multimodal interaction includes the analysis as well as the synthesis of multimodal utterances. This course concentrates on the analysis, i.e., the input processing. Input processing has the goal to derive meaning from signal to provide a computerized description and understanding of the input and to execute the desired interaction. In multimodal systems, this process is interleaved between various modalities and multiple interdependencies exist between simultaneous utterances necessary to take into account for a successful machine interpretation.

In this course, students will learn about the necessary steps involved in processing unimodal as well as multimodal input. The course will highlight typical stages in multimodal processing. Using speech processing as a primary example, they learn about:

1. A/D conversion
2. Segmentation
3. Syntactical analysis
4. Semantic analysis
5. Pragmatic analysis
6. Discourse analysis

A specific emphasis will be on stages like morphology and semantic analysis. Typical aspects of multimodal interdependencies, i.e., temporal and semantic interrelations are highlighted and consequences for an algorithmic processing are derived. Prominent multimodal integration (aka multimodal fusion) approaches are described, including transducers, state machines, and unification.

### Intended learning outcomes

After the course, the students will be able to build their own multimodal interfaces. They will have a broad understanding of all the necessary steps involved and will know prominent algorithmic solutions for each of them. Students will learn about available tools for reoccurring tasks and their pros and cons.

### Courses

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

V (2) + Ü (2)

### Method of assessment

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

Presentation of project results (approx. 40 minutes)

Language of assessment: German and/or English

Creditable for bonus

### 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>
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<tr>
<td>Embedded Systems</td>
<td>10-I=ES-161-m01</td>
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<tr>
<td>holder of the Chair of Computer Science V</td>
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<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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</tbody>
</table>

**Contents**

Models of embedded systems, implementation methods (ASIC, AISIP, micro controller), verification of embedded systems, implementation planning static, periodic and dynamic, binding problems, hardware synthesis, software synthesis.

**Intended learning outcomes**

The students are familiar with the technical possibilities for the design of embedded systems and master the most important techniques for the modelling, verification and optimisation of such systems in hardware and software.

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

V (4) + Ü (2)

**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 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

**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>

**Contents**

Intelligent agents, uninformed and heuristic search, constraint problem solving, search with partial information, propositional and predicate logic and inference, knowledge representation.

**Intended learning outcomes**

The students possess theoretical and practical knowledge about artificial intelligence in the area of agents, search and logic and are able to assess possible applications.

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

V (2) + Ü (2)

**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 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
credible for bonus
Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits):
AT, SE, KI, HCI

**Referred to in LPO 1** (examination regulations for teaching-degree programmes)

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</table>

**Contents**

Planning, probabilistic closure and Bayesian networks, utility theory and decidability problems, learning from observations, knowledge while learning, neural networks and statistical learning methods, reinforcement learning, processing of natural language.

**Intended learning outcomes**

The students possess theoretical and practical knowledge about artificial intelligence in the area of probabilistic closure, learning and language processing and are able to assess possible applications.

**Courses**

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

V (2) + Ü (2)

**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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

creditable for bonus

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits): AT,SE,KI,HCI,GE

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--
Performance Evaluation of Distributed Systems

Module title

Module coordinator
holder of the Chair of Computer Science III

Module offered by
Institute of Computer Science

ECTS 8

Method of grading numerical grade --

Duration 1 semester

Module level graduate

Other prerequisites --

Contents
Traffic theoretic models, fundamental concepts of theory of probability, transformation techniques, stochastic processes, methods for performance analysis of technical systems, queue-/traffic theory, analysis of Markov, non-Markov and time critical systems, matrix analytical method, practical examples for performance analysis of computer systems and networks: throughput and goodput analysis and other characteristics.

Intended learning outcomes
The students possess the methodic knowledge and the practical skills necessary to model technical systems by means of the theory of probability and mathematical statistics.

Courses
V (4) + Ü (2)

Method of assessment
written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

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>Systems Benchmarking</td>
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**Module coordinator**
holder of the Chair of Computer Science IX

**Module offered by**
Institute of Computer Science

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**Contents**

**Intended learning outcomes**

**Courses**

V (2) + Ü (2)

**Method of assessment**

written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English

**Allocation of places**

**Additional information**

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits):
SE, IT, ES, HCI, GE

**Referred to in LPO I**
(examination regulations for teaching-degree programmes)
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<td>Discrete Event Simulation</td>
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**Module coordinator**

holder of the Chair of Computer Science IX

**Module offered by**

Institute of Computer Science

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**Duration**

1 semester

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</table>

**Contents**

Introduction to simulation techniques, statistical groundwork, creation of random numbers and random variables, random sample theory and estimation techniques, statistical analysis of simulation values, inspection of measured data, planning and evaluation of simulation experiments, special random processes, possibilities and limits of model creation and simulation, advanced concepts and techniques, practical execution of simulation projects.

**Intended learning outcomes**

The students possess the methodic knowledge and the practical skills necessary for the stochastic simulation of (technical) systems, the evaluation of results and the correct assessment of the possibilities and limits of simulation methods.

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

V (4) + Ü (2)

**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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

creditable for bonus

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits): IT,KI,ES,GE

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

--
### Module title
Selected Topics in Algorithms

### Abbreviation
10-I=AKA-161-m01

### Module coordinator
holder of the Chair of Computer Science I
modules offered by
Institute of Computer Science

### ECTS
5

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites

### Contents
Selected topics in algorithmics and theory.

### Intended learning outcomes
The students understand the basic approach of algorithmic computer science. They are able to understand the solutions of complex problems in this area and apply them to similar questions.

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

- V (2) + Ü (2)

### 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 120 minutes).
  If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

### 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 coordinator**
holder of the Chair of Computer Science I

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

**Contents**
Selected topics in algorithmics and theory.

**Intended learning outcomes**
The students understand the basic approach of theoretical computer science. They are able to understand the solutions of complex problems in this area and apply them to similar questions.

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

V (2) + Ü (2)

**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 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

**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>Selected Topics in Software Engineering</td>
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</table>

**Contents**

Selected topics in software engineering.

**Intended learning outcomes**

The students possess an advanced knowledge about selected aspects of software engineering.

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

V (2) + Ü (2)

**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 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE.

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

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**Contents**

Selected topics in IT security.

**Intended learning outcomes**

The students possess an advanced knowledge in the area of IT security. They are able to understand solutions to complex problems in this area and to transfer them to related questions.

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

V (2) + Ü (2)

Module taught in: English

**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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

credible for bonus

Language of assessment: English

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits):

SE, KI, LR, HCI, ES, SEC

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

--
### Module title
Selected Topics in Internet Technologies

### Abbreviation
10-I=AKIT-161-m01

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

### Module offered by
Institute of Computer Science

### ECTS
5

### Method of grading
Numerical grade

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

### Duration
1 semester

### Module level
Graduate

### Other prerequisites
--

### Contents
Selected topics in computer communication, for example design aspects of future internet structures: setup and control structures of the internet, multicast protocols, protocols for multimedia communication, optical networks, control mechanisms for redundant and real-time communication networks, p2p networks, ad-hoc networks, or -- new concepts and technologies in mobile communication: digital modulation, signal propagation, channel coding, modern transmission technologies (adaptive modulation and coding, hybrid ARQ, OFDM, MIMO), mac layer, mobileIP, routing in ad-hoc networks, vertical handover, UMTS IP multimedia subsystem, or -- planning and management methods in telecommunication networks: planning methods (forward engineering, reverse engineering), network management paradigms (central and decentral), framework for network management (IETF traffic engineering, ITU-T TMN, OSI management), planning and management methods (IP management mechanisms, network design, measurement, acquisition and evaluation of traffic and performance data, visualisation, result handling, simulation and analysis of networks), management tools, outlook and perspectives, or -- other current topics.

### Intended learning outcomes
The students have a knowledge of advanced and current topics in the management and design of modern wired and wireless communication systems.

### Courses
(V (2) + Ü (2))

### Method of assessment
Written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

### Allocation of places
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### Additional information
Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits): IT.

Referred to in LPO I  (examination regulations for teaching-degree programmes)
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**Module coordinator**
holder of the Chair of Computer Science IX

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

**Contents**
Selected topics in intelligent systems.

**Intended learning outcomes**
The students possess an advanced knowledge in the area of intelligent systems. They are able to understand solutions to complex problems in this area and to transfer them to related questions.

**Courses**
(type, number of weekly contact hours, language — if other than German)
V (2) + Ü (2)

**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 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

**Language of assessment:** German and/or English

**Allocation of places**
--

**Additional information**
Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits):
KI

**Referred to in LPO I**
(examination regulations for teaching-degree programmes)
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### Module Catalogue for the Subject
**Aerospace Computer Science**
Master's with 1 major, 120 ECTS credits

<table>
<thead>
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<th>Module title</th>
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<td>Institute of Computer Science</td>
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</table>

**Contents**

Selected topics in embedded systems.

**Intended learning outcomes**

The students possess specialised knowledge in the area of embedded systems. They are able to understand solutions to complex problems in this area and to transfer them to related questions.

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

V (2) + Ü (2)

**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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): ES.

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

--
**Module title**

Selected Topics in Aerospace Engineering

**Abbreviation**

10-l=AKLR-161-m01

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<td>1 semester</td>
<td>graduate</td>
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</table>

**Module coordinator**

holder of the Chair of Computer Science VII

**Module offered by**

Institute of Computer Science

**Contents**

Selected topics in aerospace engineering, for example: satellite communication, rocket science, propulsion systems, sensors and actuators for orientation control, perturbation of orbits, interplanetary orbits, rendezvous and docking, design of space ships, design of planetary bases, life support systems, special aspects of operations, payloads, optical systems, RADAR, earth monitoring, thermo management, structure of space ships, special areas of navigation, space environment, environment simulation, verification and test of space faring systems, space astronomy and planet missions, space medicine and biology, material science, quality management, space law, aeroflight topics, avionics for airplanes, air traffic control, areal navigation, pilot interfaces, air traffic control, air traffic management.

**Intended learning outcomes**

The students possess an advanced knowledge about the respective topic of the selected area and are able to consider these foundations in their future plans of air or spaceborne systems.

**Courses**

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

V (2) + Ü (2)

**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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Separate written examination for Master's students.

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): LR.

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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<tr>
<td>Selected Topics in HCI</td>
<td>10-I=AKHCl-182-m01</td>
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<th>Duration</th>
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<td>graduate</td>
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**Contents**

Selected topics in HCI.

**Intended learning outcomes**

The students understand the basic approach of human-computer interaction. They are able to understand the solutions to complex problems in this area and to transfer them to related questions.

**Courses**

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

V (2) + Ü (2)

**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 (60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

--

**Additional information**

Focuses available for students of the Master’s programme Informatik (Computer Science, 120 ECTS credits): HCI.

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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Module title | Abbreviation
---|---
Selected Topics in Computer Science | 10-I=AKII-182-m01

| Module coordinator | Module offered by |
---|---
Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

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

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

**Contents**

Selected topics in computer science.

**Intended learning outcomes**

The students are able to understand the solutions to complex problems in computer science and to transfer them to related questions.

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

V (2) + Ü (2)

**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 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**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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Master Project Modules
(30 ECTS credits)
**Module title**  
Concluding Colloquium Aerospace Computer Science

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<th>Abbreviation</th>
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**Module coordinator**  
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**Module offered by**  
Institute of Computer Science

**ECTS**  
5

**Method of grading**  
numerical grade

**Only after succ. compl. of module(s)**  
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**Duration**  
1 semester

**Module level**  
graduate

**Other prerequisites**  
--

**Contents**

Presentation and defence of the results of the Master's thesis in an open discussion.

**Intended learning outcomes**

The students are able to present the results of their Master's theses and defend them in a discussion.

**Courses**

K (0)

**Method of assessment**

final colloquium (approx. 60 minutes)  
Language of assessment: German and/or 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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