Fundamentals of Space Technology

Module title:	**Credits:**	**Responsible person:**
Fundamentals of Space Technology	9	Yoon, Zizung
	Office:	**Contact person:**
	F 6	Yoon, Zizung
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	zizung.yoon@tu-berlin.de

Learning Outcomes

The module imparts the fundamentals of space technology. It is important for students to have a general knowledge in several space related technical and programmatic subjects in space technology, but also in the utilization of space. Goal of the module is to produce skills in design of spacecraft subsytems, selection of system solutions for different areas in astronautics and identification of critical elements of a space mission. Another goal is for the students to gain competence in handling problems in any space related subject, beeing able to make trade-offs under use of small numerical programs, being able to think systemmatically in a professional environment and being able to evaluate space system solutions.

Content

- Engineering tools (e.g. MATLAB, CAD software)
- Scientific documentation with Latex
- History of spaceflight
- Space utilization
- Space environment
- Orbital mechanics
- Rocketry
- Space propulsion
- Launch vehicle
- Re-entry
- Space stations
- Space debris
- Earth satellites

Module Components

Course Name	Type	Number	Cycle	SWS
Fundamentals of Space Technology 1	VL		SS	4
Fundamentals of Space Technology 2	VL		WS	2

Workload and Credit Points

Fundamentals of Space Technology 1 (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	8.0h	120.0h
Attendance	15.0	4.0h	60.0h
			180.0h

Fundamentals of Space Technology 2 (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	4.0h	60.0h
Attendance	15.0	2.0h	30.0h
			90.0h

The Workload of the module sums up to 270.0 Hours. Therefore the module contains 9 Credits.

Description of Teaching and Learning Methods

The module consists of a theoretical lecture, exercises and homework.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None.

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

Throughout both semesters, assignments and quizzes on the theoretical content are given.
Every student gives a short presentation about a selected topic in space engineering and his/her oral feedback on selected topics in space engineering is graded.
The course is concluded with a final test about the whole content of the lecture course.

Test elements	Categorie	Points	Duration/Extent
Presentation	flexible	10	15 min
Oral feedback	oral	10	15 min
Assignments and quizzes	flexible	40	60 h
Test	written	40	60 min

Duration of the Module

This module can be completed in 2 semesters.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:	Electronical lecture notes :
available	available

Additional information:

The script will be handed out for free in the first lecture.

Recommended literature:

Handbuch der Raumfahrttechnik, Hallmann, W. und Ley, W., München, Wien, Hanser 1999, 792 S

International Reference Guide to Space Launch Systems, Isakowitz, Steven J., American Institute of Aeronautics and Astronautics, Inc., Reston, VA, London, Eurospan 2003. - 550 S

Raumfahrtsysteme : eine Einführung mit Übungen und Lösungen, E. Messerschmidt ; S. Fasoulas. - Berlin u.a.: Springer, 2000. 533 S

Rocket propulsion elements, G. P. Sutton; O. Biblarz, 7. ed.,New York [u.a.] Wiley, 2001, 751 S

Space Stations. Systems and Utilization, E. Messerschmid, R. Bertrand, Springer 1999, 566 S

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

German for Engineers A1.1

Module title:	**Credits:**	**Responsible person:**
German for Engineers A1.1	3	Homakova, Olga
No information	**Office:**	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

During and after their studies, MSE students are most likely to collect work experience in the German aerospace sector. The module German for Engineers is designed to help students to work in the engineering environment. The module A1.1 corresponds to basic users of the language, who communicate in everyday situations with commonly-used expressions and elementary vocabulary. After completing the A1.1 module, students can understand and use very frequently-used everyday expressions as well as simple phrases to meet immediate needs. They can introduce themself and others, ask and answer questions about personal details and interact in a simple way provided the other person talks slowly and clearly.

Content

- Introductions
- Talking about personal details such as where students live, things they have and people they know.
- Counting
- Hobbies
- Ordering food, talking about food
- Expressing not having and needing things
- Talking about things
- Talking about what one can and cannot do
- Expressing prices
- Telling time
- Naming days of the week and months

Module Components

Course Name	Type	Number	Cycle	SWS
German for Engineers A1.1	UE	3534 L 819	SS	3

Workload and Credit Points

German for Engineers A1.1 (Übung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	3.0h	45.0h
Attendance	15.0	3.0h	45.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

- Individual work phases, couple and group work in classroom
- Interactive tasks for the development of speaking and writing skills and reading and listening comprehension
- Homework

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**	**Duration/Extent:**
ungraded	Written exam	German	90 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 12

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

StuPO 2014

Modullisten der Semester: SS 2020

Miscellaneous

Prerequisite for a successful completion is the regular participation in the course (at least 80%).

German for Engineers A1.2

Module title:	**Credits:**	**Responsible person:**
German for Engineers A1.2	3	Homakova, Olga
No information	**Office:**	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

During and after their studies, MSE students are most likely to collect work experience in the German aerospace sector. The module German for Engineers is designed to help students to work in the engineering environment. The module A1.2 corresponds to basic users of the language, i.e. those able to communciate in everyday situations with commonly-used expressions and elementary vocabulary. After completing the A1.2 module, students can understand and use very frequently-used everyday expressions as well as simple phrases to meet immediate needs. They can introduce themself and others, ask and answer questions about personal details and interact in a simple way provided the other person talks slowly and clearly.

Content

- Talking about daily routine, work activities
- Making appointments
- Making directions
- Describing locations
- Talking about time and duration
- Talking about taste and preferences
- Naming body parts
- Naming items of clothing
- Talking about past using Perfekt
- Expressing likes and dislikes
- Modal verbs

Module Components

Course Name	Type	Number	Cycle	SWS
German for Engineers A1.2	UE	3534 L 820	WS	3

Workload and Credit Points

German for Engineers A1.2 (Übung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	3.0h	45.0h
Attendance	15.0	3.0h	45.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

- Individual work phases, couple and group work in classroom
- Interactive tasks for the development of speaking and writing skills and reading and listening comprehension
- Homework

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

A1.1

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**	**Duration/Extent:**
ungraded	Written exam	German	90 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 12

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

StuPO 2014

Modullisten der Semester: SS 2020

Miscellaneous

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

German for Engineers A2.1

Module title:	**Credits:**	**Responsible person:**
German for Engineers A2.1	3	Homakova, Olga
No information	**Office:**	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	homakova@campus.tu-berlin.de

Learning Outcomes

During and after their studies, MSE students are most likely to collect work experience in the German aerospace sector. The module German for Engineers is designed to help students to work in the engineering environment.
After completing the A2.1 module, students can understand sentences and frequently used expressions related to areas of most immediate relevance, communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters.

Content

- Introductions
- Talking about professions, education, CV
- Talking about daily routine
- Hobbies and lessure time
- Making appointments on the phone
- Reading short messages and notes
- Reading messages and announcements at work
- Talking about frequency
- Talking about cause and effect (wenn-dann)
- Past time (Perfekt and Präteritum)
- Konjunktiv II
- Negation
- Verbs with prepositions

Module Components

Course Name	Type	Number	Cycle	SWS
German for Engineers A2.1	UE	3534 L 821	SS	3

Workload and Credit Points

German for Engineers A2.1 (Übung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	3.0h	45.0h
Attendance	15.0	3.0h	45.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

- Individual work phases, couple and group work in classroom
- Interactive tasks for the development of speaking and writing skills and reading and listening comprehension
- Homework

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

A1.2

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**	**Duration/Extent:**
ungraded	Written exam	German	90 mins

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 12

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

StuPO 2014

Modullisten der Semester: SS 2020

Miscellaneous

Prerequisite for a successful completion is the regular participation in the course (at least 80%).

German for Engineers A2.2

Module title:	**Credits:**	**Responsible person:**
German for Engineers A2.2	3	Homakova, Olga
No information	**Office:**	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

During and after their studies, MSE students are most likely to collect work experience in the German aerospace sector. The module German for Engineers is designed to help students to work in the engineering environment.
After completing the A2.1 module, students can understand sentences and frequently used expressions related to areas of most immediate relevance; communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters; describe in simple terms aspects of your background, immediate environment and matters in areas of immediate need.

Content

- Talking about travelling, countries, means of transport
- Talking about directions
- Giving recommendations (sollten)
- Describing people
- Describing items and comparing items
- Talking about plans and itinerarie
- Using the comparative and superlative
- Talking about preferences
- Adjective declension
- Relative clause
- Accusative Prepositions

Module Components

Course Name	Type	Number	Cycle	SWS
German for Engineers A2.2	UE	3534 L 822	WS	3

Workload and Credit Points

German for Engineers A2.2 (Übung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	3.0h	45.0h
Attendance	15.0	3.0h	45.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

A2.1

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**	**Duration/Extent:**
ungraded	Written exam	German	90 mins

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 12

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

Prerequisite for a successful completion is the regular participation in the course (at least 80%).

German for Engineers B1.1

Module title:	**Credits:**	**Responsible person:**
German for Engineers B1.1	3	Homakova, Olga
No information	**Office:**	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

During and after their studies, MSE students are most likely to collect work experience in the German aerospace sector. The module German for Engineers is designed to help students to work in the engineering environment by improving their basic German language skills with a focus on specialized vocabulary in engineering.

Content

- Reading and discussing professional articles
- Professional activities
- Phone conversations
- Describing graphics
- Verbs with prepositions
- Temporal prepositions
- Infinitive with zu
- Passive
- n-Deklination

Module Components

Course Name	Type	Number	Cycle	SWS
German for Engineers B1.1	UE	3534 L 823	SS	3

Workload and Credit Points

German for Engineers B1.1 (Übung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	3.0h	45.0h
Attendance	15.0	3.0h	45.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

- Individual work phases, couple and group work in classroom
- Interactive tasks for the development of speaking and writing skills and reading and listening comprehension
- Homework

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

Students of this course should have completed a minimum A2 level in German, ideally with some experience in B1 level.

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**	**Duration/Extent:**
ungraded	Written exam	German	90 mins

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 12

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

Prerequisite for a successful completion is the regular participation in the course (at least 80%).

German for Engineers B1.2

Module title:	**Credits:**	**Responsible person:**
German for Engineers B1.2	3	Homakova, Olga
No information	**Office:**	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

During and after their studies, MSE students are most likely to collect work experience in the German aerospace sector. The module German for Engineers is designed to help students to work in the engineering environment by improving their basic German language skills with a focus on specialized vocabulary in engineering.

Content

- Reading and discussing professional articles
- Mathematical operations
- Describing products and features
- Placing orders and complaints
- Present and past participle
- Konjunktiv II (present and past)
- Adjective: declination and comparison
- Auxiliary verb in passive
- Relative clauses
- Verbs with prepositions

Module Components

Course Name	Type	Number	Cycle	SWS
German for Engineers B1.2	UE	3534 L 824	WS	3

Workload and Credit Points

German for Engineers B1.2 (Übung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	3.0h	45.0h
Attendance	15.0	3.0h	45.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

- Individual work phases, couple and group work in classroom
- Interactive tasks for the development of speaking and writing skills and reading and listening comprehension
- Homework

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

Students of this course should have completed a minimum A2 level in German, ideally with some experience in B1 level.

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**	**Duration/Extent:**
ungraded	Written exam	German	90 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 12

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

Prerequisite for a successful completion is the regular participation in the course (at least 80%).

German for Engineers B1.3

Module title:	**Credits:**	**Responsible person:**
German for Engineers B1.3	3	Homakova, Olga
No information	**Office:**	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

During and after their studies, MSE students are most likely to collect work experience in the German aerospace sector. The module German for Engineers is designed to help students to work in the engineering environment by improving their basic German language skills with a focus on specialized vocabulary in engineering.

Content

- Reading and discussing professional articles
- Talking about behavior, feelings, different cultural norm
- Talking about history
- Describing countries
- Asking for opinions
- Making a presentation
- Temporal clause
- Local prepositions
- Conditional statements

Module Components

Course Name	Type	Number	Cycle	SWS
German for Engineers B1.3	UE	3534 L 825	SS	3

Workload and Credit Points

German for Engineers B1.3 (Übung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	3.0h	45.0h
Attendance	15.0	3.0h	45.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

- Individual work phases, couple and group work in classroom
- Interactive tasks for the development of speaking and writing skills and reading and listening comprehension
- Homework

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

Students of this course should have completed a minimum A2 level in German, ideally with some experience in B1 level.

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**	**Duration/Extent:**
ungraded	Written exam	German	90 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 12

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

Prerequisite for a successful completion is the regular participation in the course (at least 80%).

Human Spaceflight

Module title:	**Credits:**	**Responsible person:**
Human Spaceflight	6	Grau, Sebastian
	Office:	**Contact person:**
	F 6	Grau, Sebastian
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	sebastian.grau@tu-berlin.de

Learning Outcomes

The module imparts knowledge on the essential basics of problems in planning and operating manned space missions. In this connection, the technical aspects as conception and operation of space habitats and the medical and psychological prozesses of adaption to the space environment are discussed. This interdisciplinary approach shall enable students to understand the complexity of manned space missions in terms of technical, medical and psychological aspects and give them the skills to support the design of human spacecraft.

Content

Technical Aspects of Human Spaceflight:
- History of manned spaceflight
- Capabilities and boundaries of human in space
- Selection and training of astronauts
- Orbital equipment
- Space stations and manned spacecraft
- Habitats for Moon and Mars
- Exploration stategies and mission architectures

Space Psychology:
- Microgravity and changed day-night-cycle as specific stress factors of the space environment
- Physiological problems of adaption to zero-gravity (hear circular flow system, vestibular system, muscle and bone system, space sickness)
- Effect of microgravity on congnitive and psychomotor functions and performance
- Psychological effects of isolation and confinement on performance
- Mental stat and sozio-psychological processes within astronaut crews
- Psychological aspects of selection, training and support of astronauts

Module Components

Course Name	Type	Number	Cycle	SWS
Space Psychology	IV	0532 L 352	SS	2
Technical Aspects of Human Spaceflight	SEM	3534 L 858	WS	2

Workload and Credit Points

Space Psychology (Integrierte Veranstaltung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	4.0h	60.0h
Attendance	15.0	2.0h	30.0h
			90.0h

Technical Aspects of Human Spaceflight (Seminar)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	4.0h	60.0h
Attendance	15.0	2.0h	30.0h
			90.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

In this module, the theoretical lectures are mainly complemented by seminars. For the seminars, the students shall prepare and present work on a specific topic.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

In each lecture course, a short test about the theoretical content is written. Students select a topic on each, space psychology and technology, for which they prepare a presentation and documentation.

Test elements	Categorie	Points	Duration/Extent
Test	written	40	30 min
Paper	written	30	10 pages
Presentation	oral	30	20 min

Duration of the Module

This module can be completed in 2 semesters.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:

unavailable

Electronical lecture notes :

unavailable

Recommended literature:

Themenbereich Raumfahrtpsychologie: Kanas, N. & Manzey, D. (2008). Space psychology and psychiatry. Dordrecht: Springer

Themenbereich Raumfahrttechnik: IAA StudyGroup: The Next Steps In Exploring Deep Space - A Cosmic Study by the International Academy of Astronautics, 9 July 2004 ESA: Exploration Architecture Trade Report, 2008

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Innovation Management and Entrepreneurship

Module title:	**Credits:**	**Responsible person:**
Innovation Management and Entrepreneurship	6	Homakova, Olga
	Office:	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

Nowadays, technical knowledge is not the only competence necessary for a successful career. Many space start-ups are founded and large companies and agencies adapt to challenges using new methods of innovation management that are imparted and applied in this module.

Content

- Innovation processes and methods
- Innovation strategies
- Business models
- Entrepreneurship
- Space related aspects of entrepreneurship and funding
- Agile mangement

Module Components

Course Name	Type	Number	Cycle	SWS
Innovation Management and Entrepreneurship	IV	3633 L 8870	SS	4

Workload and Credit Points

Innovation Management and Entrepreneurship (Integrierte Veranstaltung)	Multiplier	Hours	Total
Attendance	15.0	4.0h	60.0h
Self-study of lecture materials	15.0	8.0h	120.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

Theoretical lectures, individual and groups exercises, and project work

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

none

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

Activity, engagement, experimentation and learning progress throughout the course is assessed.
The course is concluded with a final test about the whole content of the lecture course.

Test elements	Categorie	Points	Duration/Extent
Team project documentation	written	20	*No information*
Oral feedback	flexible	20	15 min
Group assignments	flexible	40	*No information*
Final presentation	oral	20	30 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 20

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Introduction to Satellite Geodesy

Module title:	Credits:	Responsible person:
Introduction to Satellite Geodesy	6	Homakova, Olga
	Office:	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

The module includes the fundamental principles of Satellite and Space Geodesy, such as geodetic, astrometric and astronomic reference frames and transformations, Earth Orientation, Satellite Orbit determination and introduces the most important space geodetic techniques: GNSS, VLBI, SLR, DORIS, Satellite Altimetry, InSAR and Gravity Field Satellite Missions. The main geophysical processes that cause changes of the antenna reference points are discussed as well, within a section on data analysis of space geodetic techniques. The students of space engineering will gain an initial overview of how Earth observing and navigation satellites as well as ground-based observatories can be used for current geoscientific and astrometric applications involving the analytical concepts of geodesy. The module consists of two parts, a lecture and the associated computer-based exercise, where the most important topics are further illustrated through practical examples.

Content

Conceptual basics of coordinate systems
Time scales
Terrestrial reference frames
Celestial reference frames
Earth orientation
Orbit determination
Space geodetic techniques: GNSS, VLBI, SLR, DORIS, satellite altimetry, spherical harmonics and gravity field, satellite-based gravity field determination, methods of space geodetic data analysis

Module Components

Course Name	Type	Number	Cycle	SWS
Introduction to Satellite Geodesy	VL	3534 L 8873	SS	4

Workload and Credit Points

Introduction to Satellite Geodesy (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	4.0h	60.0h
Homework	15.0	4.0h	60.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

Lectures (50%)
Exercises (50%): 25% - theoretical introduction and preliminary discussion of the exercises, 50% - practical exercises /homework in groups of up to five students, 25% -homework debriefing

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:	Duration/Extent:
graded	Oral exam	English	30 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

StuPO 2014

Modullisten der Semester: SS 2020

Miscellaneous

No information

Planetary Exploration and Space Robotics 1

Module title:	**Credits:**	**Responsible person:**
Planetary Exploration and Space Robotics 1	6	Kryza, Lennart
	Office:	**Contact person:**
	F 6	Kryza, Lennart
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	lennart.kryza@tu-berlin.de

Learning Outcomes

This module covers the fundamentals of planetary exploration and space robotics. Basics of planetary physics, exploration of celestial bodies by robots and in-situ resource utilization will be taught. The design, testing and operation of robotic systems in space and on planetary surfaces will be imparted and parallels to analogue system and terrestrial testbeds are taught. The knowledge will be applied in a hands-on project by working on such a terrestrial analogue system.

Content

- Basics of planetary physics
- Subsystems of planetary rover and systems design strategy
- Introduction to planetary missions
- Robot Operating System
- Student robotic system design project
- Operation of a planetary robot

Module Components

Course Name	Type	Number	Cycle	SWS
Planetary Exploration and Space Robotics 1	IV		WS	4

Workload and Credit Points

Planetary Exploration and Space Robotics 1 (Integrierte Veranstaltung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	8.0h	120.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

Theoretical lectures and project work

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

Project work is evaluated at defined milestones.
Presentations about the project status are given.
A project documentation must be prepared.

Test elements	Categorie	Points	Duration/Extent
Final documentation	written	50	*No information*
Project status report	oral	20	15 min
Presentation	oral	30	20 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:

unavailable

Electronical lecture notes :

unavailable

Recommended literature:

Alex Ellery: Planetary Rovers; Robotic Exploration of the Solar System. 2016. Published by Springer-Verlag Berlin Heidelberg. ISBN: 978-3-642-03258-5

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Planetary Exploration and Space Robotics 2

Module title:	Credits:	Responsible person:
Planetary Exploration and Space Robotics 2	6	Kryza, Lennart
	Office:	**Contact person:**
	F 6	Kryza, Lennart
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	lennart.kryza@tu-berlin.de

Learning Outcomes

This module covers the detailed design, prototyping and testing of a robotic system for a defined mission scenario. A given design problem will be solved by the students, mostly relying on results from Planetary Exploration and Space Robotics 1.

Content

- Detailed design of robot subsystems
- Project workflow
- Software design guidelines
- Team file management
- Testing and operation of robot systems

Module Components

Course Name	Type	Number	Cycle	SWS
Planetary Exploration and Space Robotics 2	IV		SS	4

Workload and Credit Points

Planetary Exploration and Space Robotics 2 (Integrierte Veranstaltung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	8.0h	120.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

Theoretical lectures, tutorials, demonstrations and project work

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

Project work is evaluated at defined milestones.
Presentations about the project status are given.
A project documentation must be prepared.

Test elements	Categorie	Points	Duration/Extent
Final documentation	written	50	*No information*
Presentation	oral	30	20 min
Project status report	oral	20	15 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:

unavailable

Electronical lecture notes :

unavailable

Recommended literature:

Alex Ellery: Planetary Rovers; Robotic Exploration of the Solar System. 2016. Published by Springer-Verlag Berlin Heidelberg. ISBN: 978-3-642-03258-5

Handbook of Space Technology

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Project Management

Module title:	Credits:	Responsible person:
Project Management	6	Homakova, Olga
	Office:	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

The course focuses on developing practical skills required for successful management of space projects.

Content

- Fundamentals of project management
- Factors of project success
- Project initiation phase and environmental scanning
- Work breakdown structure / analytic hierarchy process (AHP)
- Resources and time planning
- Risk management
- Project implementation
- Project Management Standards: PMI
- Leading a project Team by using Team Management System
- Basics of Agile Project Management (Scrum)
- Scrum versus Waterfall Project Management
- Controlling
- Team management systems
- Leadership in project calculation for project managers
- ECSS Standards

Module Components

Course Name	Type	Number	Cycle	SWS
Project Management	VL		SS	4

Workload and Credit Points

Project Management (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	8.0h	120.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

The module consists of a theoretical lecture and business games.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

none

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

- Group presentation: The teams which work together in the class Project Master give a 20-minute presentation and submit a handout (6 pages).

- Test: The course is concluded with a final test about the whole content of the lecture course.

- Group assignment: Overall performance of the "companies", based on the financial results (Quicktest) and the final presentation of the business game TOPSIM, is evaluated.

Test elements	Categorie	Points	Duration/Extent
Test	written	40	90 min
Group assignments	flexible	20	*No information*
Final presentation	oral	40	20 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 20

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
StuPO 2014
Modullisten der Semester: SS 2020

Miscellaneous

No information

Radiation Workshop

Module title:	Credits:	Responsible person:
Radiation Workshop	3	Avsar, Cem
	Office:	**Contact person:**
	F 6	Avsar, Cem
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	cem.avsar@tu-berlin.de

Learning Outcomes

The workshop allows students to get deep insights into the effects of space radiation and the methods of mitigating space radiation effects.

Content

- Radiation concept and units
- Preparation of a total ionizing dose (TID) irradiation test setup with electronic components
- Space radiation environment and its effects on electronics
- Detailed TID effects in electronics
- Single Event Effects (SEE) in electronics
- Introduction to computational tools and calculation of radiation models
- Simulation of radiation effects on electronics
- Hands-on radiation test campaign in a radiation chamber

Module Components

Course Name	Type	Number	Cycle	SWS
Radiation Workshop	IV		WS	2

Workload and Credit Points

Radiation Workshop (Integrierte Veranstaltung)	Multiplier	Hours	Total
Attendance	15.0	4.0h	60.0h
Self-study of lecture materials	15.0	2.0h	30.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

In the radiation workshop, students conduct experiments in a radiation chamber to see and measure the effects of radiation on electronics. The foundations of space radiation and its effects are imparted in theoretical lectures.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

Fundamentals of Space Technology
Space Electronics

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:	Duration/Extent:
graded	Written exam	English	90 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Recommended literature:
None.

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Satellite Communication

Module title:	Credits:	Responsible person:
Satellite Communication	6	Brieß, Klaus
	Office:	**Contact person:**
	F 6	Lange, Sebastian
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	klaus.briess@tu-berlin.de

Learning Outcomes

Participants who complete this course will gain solid knowledge in radio communication and signal processing. They will understand the working principles of hardware and software related to satellite communication. In combination with the knowledge and skills gained in previous courses in space engineering, the participants will be able to set up a satellite communication link. In scope of a curricular project, the participants will build a ground station in interdisciplinary teams. They will scientifically document and present their work at the end of the project.

Content

- Applied technical know-how regarding the transmission of radio signals: characteristics of electromagnetic waves, components for transmitter and receiver circuits, antennas, transmission path, modulation and encoding schemes, operating modes, EMC etc.
- Practical hardware and/or software design as well as manufacturing resp. implementation
- Using electrical and HF measuring instruments
- Methodogically planning an organizing a project
- Scientific documentation and presentation of the practical work

Module Components

Workload and Credit Points

Course-independent workload	Multiplier	Hours	Total
Project documentation (Paper)	1.0	48.0h	48.0h
Preparation and self-reliant project work	14.0	6.0h	84.0h
Attendance	14.0	2.0h	28.0h
Preparation of project presentation	1.0	20.0h	20.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

One or multiple projects in the field of satellite communication, partly chosen by the students itself, will be realized in structured teams. Each group or sub-team develops its part of the overall project and will be supported by experienced advisors. The knowledge needed to elaborate a specific subtask will be taught in small workshops. The groups document their work in form of a paper and present their results together in a final presentation.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

- Space Mission Planning and Operations
- Satellite Technology

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

This exam uses its own grading scale (see test description)..

Test description:

The project work is evaluated based on intermediate presentation and documentation. The final presentation is graded (15 min presentation, 5 min demo, 10 min Q&A).
The final documentation with 2 to 5 pages per person (paper) is graded.

Test elements	Categorie	Points	Duration/Extent
Final presentation	flexible	20	20 min
Project documentation (Paper)	flexible	50	2 - 5 pages per person
Project work	flexible	30	*No information*

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 6

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

StuPO 2014

Modullisten der Semester: SS 2020

Miscellaneous

Within the conceptual framework of the meta-project "Space Interdisciplinary studies in the fields of Robotics and Radio communications" (SIERRA) the focus is currently on the interdisciplinary cooperation of the Chair of Space Technology and the Chair of High Frequency Technology, supported by the Amateur Radio Club of TU Berlin (AfuTUB / DK0TU).

Satellite Geodesy

Module title:	**Credits:**	**Responsible person:**
Satellite Geodesy	6	Schuh, Harald
	Office:	**Contact person:**
	H 12	Schuh, Harald
Website:	**Display language:**	**E-mail address:**
http://www.igg.tu-berlin.de	Englisch	harald.schuh@tu-berlin.de

Learning Outcomes

After this module the students are familiar with the most important observation methods in space geodesy and how the data is analysed. They know the strengths and weaknesses of the individual techniques, how they contribute to measure the three pillars of geodesy (Earth shape, Earth rotation and Earth gravity field) and what type of phenomena and processes in the Earth system they can observe and monitor. They understand that only the integrated analysis of a variety of complementary sensors allows the separation of different processes of global change in the Earth system.

Content

Measurement principles of the most important space- and ground-based geodetic observation techniques:
- Very Long Baseline Interferometry (VLBI)
- Satellite and Lunar Laser Ranging (SLR/LLR)
- Global Navigation Satellite Systems (GNSS, including GPS, GLONASS, GALILEO,)
- Doppler Orbitography and Radio positioning Integrated by Satellite (DORIS)-
- Ocean and ice altimetry
- InSAR and gravity field satellite missions and innovative future concepts.

The application of these techniques to determine the three pillars of space geodesy:
- The Earth’s geometry and deformation
- The Earth orientation and rotation
- The Earth gravity field and its temporal variations

Further topics:
- Methods to solve huge parameter estimation problems and for time series analyses are explained and applied
- Estimation/monitoring of station motion and surface deformationd
- Models of the processes deforming the Earth‘s surface like plate tectonics, post-glacial rebound, solid Earth tides, surface loads
- Importance of deformation measurements for natural hazards and early warning systems
- Methods to determine the global gravity field of the Earth and its temporal variability including satellite to satellite tracking, satellite gravity gradiometry (SGG) and altimetry
- Orbit determination methods
- Static gravity field as reference surface and information about the structures and processes in the Earth‘s interior
- Geodetic and geophysical models of the Earth orientation and rotation including effects of Sun, Moon and planets, and of the different components of the Earth system
- Comparisons with observed Earth orientation parameters series
- GNSS remote sensing comprising atmospheric sounding from ground and space, determination of water vapor in the troposphere and the electron density in the ionosphere
- GNSS reflectometry and scatterometry
- Importance for meteorology, weather forecasts and climatology

Module Components

Course Name	Type	Number	Cycle	SWS
Geodetic Space Procedures in the Earth System Research	IV	3633 L 241	WS	4

Workload and Credit Points

Geodetic Space Procedures in the Earth System Research (Integrierte Veranstaltung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	8.0h	120.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

Lectures (70%)
Exercises (20%)
Discussions (10%)

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

Basic knowledge about space reference systems, data anlysis, satellite orbits and satellite navigation

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:	Duration/Extent:
graded	Oral exam	English	30 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:	Electronical lecture notes :
unavailable	*unavailable*

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Satellite Technology

Module title:	Credits:	Responsible person:
Satellite Technology	6	Avsar, Cem
	Office:	**Contact person:**
	F 6	Avsar, Cem
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	cem.avsar@tu-berlin.de

Learning Outcomes

The module imparts the basics of satellite technology. In this context, all segments of a satellite mission are discussed. Especially, all subsystems of a satellite and their interdependencies are presented by experts. The technologies and design processes are treated in detail. Students shall develop a well-founded base of knowledge about every aspect of a complex satellite system. The skills imparted in this module are valuable for making valuations on satellite subsystems. This shall support the systems engineering competence of the students.

Content

- Classification of satellites
- Electrical Power Subsystem (EPS)
- Thermal Control Subsystem (TCS)
- Structure and Mechanisms (S&M)
- Attitude Control Subsystem (ACS)
- On-Board Computer (OBC)
- Telemetry, Tracking & Command (TT&C)
- Satellite propulsion

Module Components

Course Name	Type	Number	Cycle	SWS
Satellite Technology	VL		SS	4

Workload and Credit Points

Satellite Technology (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	8.0h	120.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

The course covers all subsystems of satellites in technical detail. Several subsystem experts give lectures on specific aspects of satellite technologies and further elaborate on their field of work with examples from real satellite missions. Comprehensive homework exercises about every subsystem help the student to deepen the knowledge and apply engineering skills and tools for defining satellite subsystems.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None.

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

There are assignments which contain tasks related to every satellite subsystem. The written test and the oral feedback contain questions about the theoretical content of the lecture course.

Test elements	Categorie	Points	Duration/Extent
Test	written	33	45 min
Assignments	flexible	33	80 h
Oral feedback	oral	34	20 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Recommended literature:

Elements of Spacecraft Design, C.D. Brown, AIAA, 2002
Handbuch der Raumfahrttechnik, Hallmann, W. und Ley, W., München, Wien, Hanser 1999, 792 S
Raumfahrtsysteme: eine Einführung mit Übungen und Lösungen, E. Messerschmidt ; S. Fasoulas. - Berlin u.a.: Springer, 2000. 533 S
Space Vehicle Mechanisms, P.Conley, New York, 1998
Spacecraft Structure and Mechanisms, T.P. Sarafin, Kluwer 1995

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Soft Skills

Module title:	Credits:	Responsible person:
Soft Skills	3	Homakova, Olga
	Office:	**Contact person:**
	F 6	Homakova, Olga
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de/	Englisch	olga.homakova@tu-berlin.de

Learning Outcomes

Skills in communication and social competence are key factors for prospective engineers seeking leading positions. The module will prepare students for the social challenges in the work environment and provide a basic understanding and a hands-on experimentation space for the key soft skills required to lead employees, teams and organisations. In immersive real-life situations, students will train and develop their abilities in teamwork, adaptability, collaborative problem solving and other key transferrable soft skills.

Content

- Communication skills
- Teamwork and collaboration
- Active listening
- Critical observation
- Feedback and feedforward
- Story telling
- Collaborative problem solving and decision making

Module Components

Course Name	Type	Number	Cycle	SWS
Soft Skills	VL		SS	4

Workload and Credit Points

Soft Skills (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	2.0h	30.0h
Self-study of lecture materials	15.0	4.0h	60.0h
			90.0h

The Workload of the module sums up to 90.0 Hours. Therefore the module contains 3 Credits.

Description of Teaching and Learning Methods

Theoretical lectures, individual and group exercises, role plays

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

none

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

Activity, engagement, experimentation and learning progress throughout the course is assessed.
The course is concluded with a final test about the whole content of the lecture course.

Test elements	Categorie	Points	Duration/Extent
Oral feedback	flexible	10	15 min
Written test	written	90	90 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

The maximum capacity of students is 20

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Space Electronics

Module title:	**Credits:**	**Responsible person:**
Space Electronics	6	Avsar, Cem
	Office:	**Contact person:**
	F 6	Avsar, Cem
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	avsar@campus.tu-berlin.de

Learning Outcomes

Nowadays, a well-founded practical knowledge in electronics is inevitable for space systems engineers. Electronics and hardware-near software are significant parts of any space mission. The systems engineer shall understand the main requirements on spacecraft equipment and their interconnections with respect to electrical characteristics and interfaces. The module imparts the practical skills relevant to designing hardware and software for a spacecraft. With completion of the course, students shall be able to conceptualize an electronics system, define interfaces, design and manufacture printed circuit boards and write hardware-near software in context of spacecraft systems.

Content

- Basics of electronics
- Analog electronics
- Design of electronics circuits
- Handling of laboratory equipment
- Digital electronics
- Programming of microcontrollers
- Hardware and software of satellite systems

Module Components

Course Name	Type	Number	Cycle	SWS
Space Electronics 1	VL		SS	2
Space Electronics 2	VL		WS	2

Workload and Credit Points

Space Electronics 1 (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	2.0h	30.0h
Pre/post processing	15.0	4.0h	60.0h
			90.0h

Space Electronics 2 (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	2.0h	30.0h
Pre/post processing	15.0	4.0h	60.0h
			90.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

The course is highly practice-oriented. All students receive a comprehensive package of electronics parts and measurement equipment in the beginning of each semester. Theoretical contents converts directly into practical experience during the lectures in which the electronics parts are used. There are multiple hands-on homework exercises throughout the semester in which students build circuits and write software. In addition, specific space-related aspects of electronics are covered in guest lectures. During both semesters, a joint project with the lecture course Spacecraft Dynamics and Control is conducted. Small teams of students build a FloatSat with different sensors and actuators. The FloatSat is put on an air-bearing table and shall perform attitude control maneuvers. The electrical design, manufacturing and demonstration of core functionalities are assessed in scope of the Space Electronics lecture course.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None.

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

There are assignments due every three to four weeks. The hardware kit is used to complete the practical assignments.
The FloatSat group project is graded based on each team's results in the project emonstration.
The written test covers the theoretical content of the lecture course.

Test elements	Categorie	Points	Duration/Extent
Test	written	20	45 min
Assignments	flexible	50	40 h
Project work	flexible	30	40 h

Duration of the Module

This module can be completed in 2 semesters.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Recommended literature:

Elementare Elektronik, K. Beuth; O. Beuth, Vogel Verlag, 2003
Grundlagen der Elektronik, S. Goßner, Shaker Verlag, 2005
Halbleiter-Schaltungstechnik, U.Tietze; Ch. Schenk, Springer Verlag, 2002
Handbuch der Raumfahrttechnik, W. Hallmann; W. Ley, Hanser Verlag 1999
Lernpaket Elektronik, B. Kainka; Franzis, 2006
MAKE Electronics, C. Platt; O'Reilly, 2009
Schnellstart LEDs, B. Kainka; Franzis, 2005
Sensorschaltungstechnik, W. Schmidt, Vogel Verlag, 2007
Space Mission Analysis and Design, W. Larson; J. Wertz, Kluwer, 1999

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Space Flight Mechanics

Module title:	Credits:	Responsible person:
Space Flight Mechanics	6	Grau, Sebastian
	Office:	**Contact person:**
	F 6	Grau, Sebastian
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	sebastian.grau@tu-berlin.de

Learning Outcomes

Goal of the module is to develop a groundlaying knowledge in the basics of space flight mechanics. The course covers all types of orbits and their disturbances, covering the laws of celestial mechanics, time and reference systems. For the students it is important to develop skills in solving mathematical navigational problems under usage of solving algorithms. The competencies gained are systematically analysing problems, developing qualitative solutions and programming software.

Content

- Two-body problem
- Undisturbed satellite orbits
- Time and reference systems
- Gravitative and non-gravitative forces
- Perturbation theory
- Orbit integration
- Special orbits
- Relative motion
- Interplanetary orbits and ascension
- Special problems of orbital mechanics
- Impulsive orbit transitions
- Re-entry of spacecraft
- Applications

Module Components

Course Name	Type	Number	Cycle	SWS
Space Flight Mechanics	VL		SS	4

Workload and Credit Points

Space Flight Mechanics (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	4.0h	60.0h
Self-study of lecture materials	15.0	8.0h	120.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

The module consists of a theoretical lecture, exercises and homework. During the excersises, solutions of orbit calculations are presented and discussed by students under supervision of the lecturers.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

Fundamentals of Space Technology
Satellite Technology
Spacecraft Dynamics and Control

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:	Duration/Extent:
graded	Oral exam	English	No information

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Recommended literature:
Fundamentals of Astrodynamics and Applications, Vallado, D.A., New York, 1997
Fundamentals of Astrodynamics, Bate, R.R. et al, 1971
Raumfahrtsysteme : eine Einführung mit Übungen und Lösungen, E. Messerschmidt ; S. Fasoulas. - Berlin u.a.: Springer, 2000. 533 S.
Satellite Orbits, Montenbruck, O., Gill, E., Springer 2000
Understanding Space, Sellers, J.J., New, York, 1997

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Space Mission Planning and Operations

Module title:	**Credits:**	**Responsible person:**
Space Mission Planning and Operations	6	Ohe, Martin
	Office:	**Contact person:**
	F 6	Ohe, Martin
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	martin.buscher@tu-berlin.de

Learning Outcomes

Goal of the module is to impart knowledge on several programmatic aspects of space missions. This includes a good knowledge of the international activities in astronautics. One focus of the module is set on gaining competencies in planning a space mission through its whole life cycle. Another focus is set on mission operations, which covers setting up ground stations and mission control structures, as well as handling procedures for mission operations.

Content

Basics of space mission planning; space activities of ESA, NASA, Germany, France; basics of space operations; satellite operations; ground station concepts; space operations centres (GSOC, ESOC); tools for space mission planning; regulatory aspects for space missions (space law, space debris, frequency coordination); project on mission design.

Module Components

Course Name	Type	Number	Cycle	SWS
Space Mission Planning and Operations	VL		SS	4

Workload and Credit Points

Space Mission Planning and Operations (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	4.0h	60.0h
Self-study of lecture materials	15.0	8.0h	120.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

The module consists of theoretical lectures and a small project. In practical exercises, mission operation tasks are conducted in a mission control room under supervision of the lecturer.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

None

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

Quiz: 30 minute quiz (multiple choice & short answer) on lecture content
Presentation: 10 minute (including Q&A) presentation on the mission design project
Documentation: Short paper (4 pages) on mission design project)
Oral feedback: 0 to 10 points based on activity during lectures

Test elements	Categorie	Points	Duration/Extent
Documentation	written	30	4 pages
Quiz	written	30	30 min
Presentations	oral	30	10 min
Oral feedback	oral	10	15 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
available

Electronical lecture notes :
unavailable

Additional information:
The script will be handed out for free in the first lecture.

Recommended literature:
Handbuch der Raumfahrttechnik, Hallmann, W. und Ley, W., München, Wien, Hanser 1999, 792 S
International Reference Guide to Space Launch Systems, Isakowitz, Steven J., American Institute of Aeronautics and Astronautics, Inc., Reston, VA, London, Eurospan 2003. - 550 S
Raumfahrtsysteme : eine Einführung mit Übungen und Lösungen, E. Messerschmidt ; S. Fasoulas. - Berlin u.a.: Springer, 2000. 533 S
Rocket propulsion elements, G. P. Sutton; O. Biblarz, 7. ed.,New York [u.a.] Wiley, 2001, 751 S
Space Stations. Systems and Utilization, E. Messerschmid, R. Bertrand, Springer 1999, 566 S

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Space Sensors and Instruments

Module title:	**Credits:**	**Responsible person:**
Space Sensors and Instruments	6	Brieß, Klaus
	Office:	**Contact person:**
	F 6	Brieß, Klaus
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	klaus.briess@tu-berlin.de

Learning Outcomes

The module covers the basics of remote sensing with spacecraft. After some system-theoretical and electronic fundamentals space sensors for gamma rays, X-rays, Ultra-Violet and visible light, for infrared and far infrared radiation and for microwaves are discussed. Calibration and ground data processing are elaborated finally.

Content

- Introduction to Earth observation
- Electromagnetic waves
- Earth observation system theory
- Sensor electronics
- Gama-ray sensors
- UV and optical space sensor systems
- Infrared sensor systems
- Microwave sensor systems
- Sensor data processing
- Sensor calibration.

Module Components

Course Name	Type	Number	Cycle	SWS
Space Sensors and Instruments	VL	3435 L 7270	WS/SS	4

Workload and Credit Points

Space Sensors and Instruments (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	4.0h	60.0h
Self-study of lecture materials	15.0	4.0h	60.0h
Project work	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

The module consists of a theoretical lecture and seminars.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

- Basic knowledge about space technologies
- Basic knowledge about satellite technolgies
- Basic knowledge about space flight mechanics

Mandatory requirements for the module test application:

No information

Module completion

Grading:	**Type of exam:**	**Language:**
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

A group project is conducted in which the design and application of space sensors and instruments are in focus. The weekly group status reports, the final presentation and the project documentation are graded.

Test elements	Categorie	Points	Duration/Extent
Project presentation	flexible	40	30 min
Oral feedback	flexible	20	*No information*
Project documentation	flexible	40	*No information*

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
available

Electronical lecture notes :
available

Additional information:

The script will be handed out for free in the first lecture.

Recommended literature:

Elachi, Charles: Introduction to the physics and techniques of remote sensing / Charles Elachi. - New York [u.a.] : Wiley, 1987., 413 S.

Goodman, Joseph W.: Introduction to Fourier optics / Joseph W. Goodman. - 2. ed. . - New York, NY [u.a.] : McGraw Hill, 1996. 441 S.

Heinz Stoewer, Berndt P. Feuerbacher: Utilisation of Space, Springer, Berlin (Dezember 2005)

Jahn, Herbert: Systemtheoretische Grundlagen optoelektronischer Sensoren / Herbert Jahn ; Ralf Reulke. - 1. Aufl. . - Berlin : Akad.-Verl., 1995. - 298 S.

Kramer, Herbert J.: Observation of the earth and its environment : survey of missions and sensors ; with 857 tables. Herbert J. Kramer. - 4. ed. - Berlin: Springer, 2002. 1510 S.

Kreß, Dieter: Angewandte Systemtheorie : kontinuierliche und zeitdiskrete Signalverarbeitung / Dieter Kreß ; Ralf Irmer. - München [u.a.] : Oldenbourg, 1990. - 336 S.

Unbehauen, Rolf: Systemtheorie : Grundlagen für Ingenieure. München, Wien, Oldenbourg, 1990. 746 S.

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
StuPO 2014
Modullisten der Semester: SS 2020

Miscellaneous

No information

Space System Design Project

Module title:	Credits:	Responsible person:
Space System Design Project	9	Ohe, Martin
	Office:	**Contact person:**
	F 6	Ohe, Martin
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	martin.buscher@tu-berlin.de

Learning Outcomes

The module imparts the basics of methodical approaches of spacecraft design for all segments of a space mission. A focus is set on design steps for spacecraft subsystems. The students shall be able to design any subsystem of a spacecraft to a certain degree. Methods of system verification, fault tolerant design and cost estimation shall be part of the basic knowledge of a prospective space systems engineer. Another focus in this course is to gain experience in working within an interdisciplinary group. Discussion and definition of interfaces, making compromises in trade-offs and focusing on a common goal in a team are daily routine in spacecraft engineering.

Content

- Spacecraft system planning
- Space environment and considerations on designing a spacecraft
- System integration
- System verification
- Space mission cost estimation
- Space law
- Phases and life cycle of a space project
- Design reviews
- Space project documentation

Module Components

Course Name	Type	Number	Cycle	SWS
Space System Design Project	VL		WS	4

Workload and Credit Points

Space System Design Project (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	4.0h	60.0h
Self-study of lecture materials	15.0	14.0h	210.0h
			270.0h

The Workload of the module sums up to 270.0 Hours. Therefore the module contains 9 Credits.

Description of Teaching and Learning Methods

Theoretical lectures and project work

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

- Basics about space technologies
- Basics about satellite technologies

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

A quiz covers questions related to the theoretical content of the lecture course.
The project status shall be presented in a midterm and a final presentation.
The project work shall be documented.

Test elements	Categorie	Points	Duration/Extent
Final presentation	flexible	30	15 min
Project documentation	flexible	25	40 h
Midterm presentation	flexible	20	15 min
Quiz	written	25	30 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:

unavailable

Electronical lecture notes :

unavailable

Recommended literature:

Elements of Spacecraft Design, C.D. Brown, AIAA, 2002
Handbuch der Raumfahrttechnik, Hallmann, W. und Ley, W., München, Wien, Hanser 1999, 792 S.
Raumfahrtsysteme : eine Einführung mit Übungen und Lösungen, E. Messerschmidt ; S. Fasoulas. - Berlin u.a.: Springer, 2000. 533 S.
Space Mission Analysis and Design, W. Larson, J. Wertz, Kluwer, 1999
Space Vehicle Mechanisms, P.Conley, New York, 1998
Spacecraft Structure and Mechanisms, T.P. Sarafin, Kluwer, 1995

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Space Technology Project

Module title:	Credits:	Responsible person:
Space Technology Project	9	Avsar, Cem
	Office:	**Contact person:**
	F 6	Avsar, Cem
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	cem.avsar@tu-berlin.de

Learning Outcomes

The module imparts the basics of the methodical design of spacecraft from the hands-on perspective. A focus is set on gaining practical design skills, especial in the area of electromechanics and informatics. The students shall be able to design a near-spacecraft type subsystem on a comparatively small scale. In a practical project, e.g. the development and launch of a CanSat or Free-Falling Unit (FFU) for sounding rocket experiments, students shall gain experience in working within an interdisciplinary group. The students are learning to structure, plan and perform individual technical tasks in a multidisciplinary team to realize a space mission or experiment within a short timeframe. Discussion and definition of interfaces, making compromises in trade-offs and focusing on a common goal in a team are daily routine in spacecraft engineering.

Content

- Electronics design
- Definition of requirements
- Electromechanical interface definition
- Project planning and design according to standards
- Cost estimation
- Phases of a space mission
- Project reviews

Module Components

Course Name	Type	Number	Cycle	SWS
Space Technology Project	VL		SS	4

Workload and Credit Points

Space Technology Project (Vorlesung)	Multiplier	Hours	Total
Attendance	15.0	4.0h	60.0h
Self-study of lecture materials	15.0	14.0h	210.0h
			270.0h

The Workload of the module sums up to 270.0 Hours. Therefore the module contains 9 Credits.

Description of Teaching and Learning Methods

Project Work

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

- Basics of space technolgies
- Basics of satellite technologies
- Basics of analog and digital electronics
- Basics of Space System Design

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

The lecturer and the student agree on project milestones which can be in the form of (presentations, demonstrations, documentation and more).

Test elements	Categorie	Points	Duration/Extent
Final documentation	flexible	20	8 pages
Final presentation	flexible	20	20min
Jointly defined project milestones	flexible	60	210 h

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
unavailable

Electronical lecture notes :
unavailable

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

StuPO 2014

Modullisten der Semester: SS 2020

Miscellaneous

No information

Spacecraft Dynamics and Control

Module title:	Credits:	Responsible person:
Spacecraft Dynamics and Control	9	Yoon, Zizung
	Office:	**Contact person:**
	F 6	Yoon, Zizung
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	zizung.yoon@tu-berlin.de

Learning Outcomes

The module provides the theory and practical application for spacecraft dynamics and control. The students should learn all relevant elements to design and analyze an attitude control system. Thus the goal of the module for the students is to gain theoretical knowledge for spacecrafts attitude control, model dynamic systems and implement the control theory in a real control system.

Content

- Mission analysis and requirements on attitude control systems
- Various possibilities of parameterization of spacecraft attitudes
- Kinematics of attitude control; Rigid body dynamics
- Attitude determination (deterministically, statistically)
- Classical control theory (Root locus, PID-controller)
- Model-based state prediction
- Basics and methods of state control

Module Components

Course Name	Type	Number	Cycle	SWS
Spacecraft Dynamics and Control 1	VL		SS	2
Spacecraft Dynamics and Control 2	VL		WS	4

Workload and Credit Points

Spacecraft Dynamics and Control 1 (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	4.0h	60.0h
Attendance	15.0	2.0h	30.0h
			90.0h

Spacecraft Dynamics and Control 2 (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	4.0h	60.0h
Project	15.0	4.0h	60.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 270.0 Hours. Therefore the module contains 9 Credits.

Description of Teaching and Learning Methods

The module consists of lectures, programming exercises, homework and group project work.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

- Basic knowledge about satellite technologies
- Basic knowledge about space flight mechanics

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:
graded	Portfolio examination 100 points in total	English

Grading scale:

Note:	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0
Punkte:	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0

Test description:

No information

Test elements	Categorie	Points	Duration/Extent
Project	flexible	34	*No information*
Written exam	written	33	60 min
Homework	flexible	33	*No information*

Duration of the Module

This module can be completed in 2 semesters.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations.
Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:
available

Electronical lecture notes :
available

Additional information:

The script will be handed out for free in the first lecture.

Recommended literature:

James Wertz, Spacecraft Attitude Determination and Control, Dortrecht 1991
Marcel Sidi, Spacecraft Dynamics and Control, Cambrindge Press, 2000
Peter Berlin, Satelllite Platform Design, Kiruna 2005
Peter Hughes, Spacecraft Attitude Dynamics, Dover Publication Inc, 2004
Wiley Larson, James Wertz, Space Mission Analysis and Design, Dordrecht, 1999

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)
- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information

Spacecraft Propulsion Systems

Module title:	Credits:	Responsible person:
Spacecraft Propulsion Systems	6	Brieß, Klaus
	Office:	**Contact person:**
	F 6	Brieß, Klaus
Website:	**Display language:**	**E-mail address:**
http://www.mse.tu-berlin.de	Englisch	klaus.briess@tu-berlin.de

Learning Outcomes

The module gives a technical overview on rocket and spacecraft propulsion systems. Students will understand the basic principles and system solutions for a large variety of propulsion technologies.

Content

- Basics of orbital mechanics
- Theoretical basics of rocket propulsion systems
- Chemical propulsion systems
- Propellants for space applications
- Propellant tanks and fuel supply
- Combustion chambers
- Thrust vector control
- Initial aid systems
- Test facilities
- Electrical propulsion systems
- Nuklear propulsion systems
- New types of propulsion systems

Module Components

Course Name	Type	Number	Cycle	SWS
Spacecraft Propulsion Systems	VL		SS	4

Workload and Credit Points

Spacecraft Propulsion Systems (Vorlesung)	Multiplier	Hours	Total
Self-study of lecture materials	15.0	8.0h	120.0h
Attendance	15.0	4.0h	60.0h
			180.0h

The Workload of the module sums up to 180.0 Hours. Therefore the module contains 6 Credits.

Description of Teaching and Learning Methods

The module consists of theoretical lectures and seminars. Some seminars are elaborated by students themselves and supervised by the lecturers. Instead of seminars and excercises a project can be conducted.

Requirements for participation and examination

Desirable prerequisites for participation in the courses:

- Basic knowledge about space technologies
- Basic knowledge about satellite technologies
- Basic knowledge about space flight mechanics

Mandatory requirements for the module test application:

No information

Module completion

Grading:	Type of exam:	Language:	Duration/Extent:
graded	Oral exam	English	30 min

Duration of the Module

This module can be completed in one semester.

Maximum Number of Participants

This module is not limited to a number of students.

Registration Procedures

Registration at the MSE secretary according to the MSE study and examination regulations. Dates and deadlines will be announced by semester start.

Recommended reading, Lecture notes

Lecture notes:

unavailable

Electronical lecture notes :

unavailable

Recommended literature:

Handbuch der Raumfahrttechnik, Ley, W., Wittmann, K., Hallmann, W., München, Wien, Hanser 2008. 814S.

International Reference Guide to Space Launch Systems, Isakowitz, Steven J., American Institute of Aeronautics and Astronautics, Inc., Reston, VA, London, Eurospan 2003. - 550 S.

Raumfahrtsysteme : eine Einführung mit Übungen und Lösungen, E. Messerschmidt ; S. Fasoulas. - Berlin u.a.: Springer, 2000. 533 S.

Rocket propulsion elements, G. P. Sutton; O. Biblarz, 7. ed.,New York [u.a.] Wiley, 2001, 751 S.

Assigned Degree Programs

This module is used in the following modulelists:

Space Engineering (Master of Science)

- StuPO 2014
  - Modullisten der Semester: SS 2020

Miscellaneous

No information