CURRICULUM

for the
Master's Programme

"SpaceTech"

Master of Engineering in Space Systems and Business Engineering

at Graz University of Technology

Revision

The Senate of Graz University of Technology approved the revision of this curriculum during its meeting on 29 January 2018.

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Curriculum for the Master's Programme SpaceTech (MEng)

General Regulations

§ 1. Qualification profile

(1) Initial situation

The space sector is a fast growing segment. It features newest research activities and offers the possibility to transfer newly developed technologies in practical use cases. The space sector was originally dominated by governmental organizations, but the last decades show a strong shift towards private companies and industry, that successfully develop new products. Examples are satellite services in communications, navigation and remote sensing areas, space transportation, space tourism or future mining of rare materials on extra-terrestrial bodies.

Space industries have, over the years, tended to become multinational in nature. In Europe in particular, mergers and acquisitions have resulted in there being, instead of many potential prime contractors in different countries competing for future satellite or launch vehicle contracts, now only a few large trans-national space companies competing with each other. Thus, a demand identified by both industry and agencies was the need to provide training to their prospective future systems engineers and program managers to prepare them to work in or direct international teams. Industry in particular must have staff that is both highly qualified technically and which understand and can implement the modern business practices that are necessary to run a profitable business in today's competitive environment. In the space sector, a thorough understanding of both Systems and Business Engineering is a key for the efficient development, marketing and successful sales of innovative products. Furthermore, in order to operate in a multinational team environment, there must also be employees, particularly at managerial level and above, who understand the cultural and linguistic differences between team members of different nationalities and backgrounds.

(2) Programme objective

The worldwide space sector needs highly qualified staff in order to be able to integrate technical, systems, business, managerial and personal skills for the realization of successful products. SpaceTech satisfies this need. Its mission statement has been defined in a lengthy process involving all stakeholders of the program. It is stated as:

> *The SpaceTech program educates international mid-career professionals seeking top-level expertise in space systems and business engineering.*

The vision for the programme has been defined as:

> *SpaceTech develops tomorrow's world-class leaders in Space Systems and Business Engineering and prepares mid-career professionals for key roles in space systems and business engineering through world-class education in an international environment*

The master's programme covers the following topics:

- Project Management
- Business Engineering
- Space Mission Analysis and Design
- Telecommunications
- Earth Observation
- Systems Engineering
- Navigation
- Human Space Flight
- Interpersonal Skills & Leadership Development

(3) Target audience

The master's programme SpaceTech is targeted to international mid-career professionals seeking top-level expertise in space systems and business engineering. It develops tomorrow's world-class leaders in Space Systems and Business Engineering. This programme prepares mid-career professionals for key roles in space systems and business engineering through excellent education in an international environment.

(4) Teaching and learning plan

This programme features lectures of internationally recognized lecturers from universities and space institutions, an intensive team-working environment in multi-cultural teams, the education of multidisciplinary topics and independent work on individual master's thesis of each student. Admission requirements comprise at least a bachelor's degree in science or business engineering and at typically three years of relevant professional experience in the aerospace sector.

The SpaceTech programme is designed as study with distance learning elements including presence sessions, which can be attended by students while they continue to work. It also features, as one important element, a Central Case Project (CCP) on which all students work, both separately and collectively.

The Central Case Project is a real-world project, in which, using what they have learned from the lectures as well as what they know from their individual backgrounds, the students are required to form a virtual company, design a suitable space and ground segment addressing a particular aspect of space which that company could market, and then demonstrate that their designs indeed have a sufficient market to be able to support a credible and profitable business case.

The SpaceTech master's programme consists of the following:

- Formal classroom instruction in six technical modules, one business module, and one Module Interpersonal Skills and Leadership Development
- An online course on applied project management for space systems. The aim of this course is to prepare the participants to assign tasks among themselves, to learn by doing and to use team building to develop necessary project management skills
- Completion and defence of a satisfactory CCP case, through graded presentations to audiences of both their SpaceTech faculty members and invited experts and executives from the space world, and finally
- Preparation and defence of individual masters theses
- Seminar on Selected Topics on Space Systems Engineering, including writing of an Individual Paper (submitted and approved)

(5) Educational outcomes and future fields of work

After completion of this programme, the graduates have acquired extensive knowledge in the areas of space systems and business engineering and gained practical experience in individual and multicultural teamwork. This enables them to perform a variety of leadership roles in the international aerospace industry.

Future areas of work are management positions in the aerospace sector, whether in industry or in various space agencies. This international education, the multidisciplinary content and the trained leadership skills prepare the graduates of this master's programme optimal for demanding leadership positions.

(6) Assessment concept (examination)

For quality assurance, a check of the educated knowledge is performed for most courses in written or oral form (see § 10).

§ 2. ECTS credits, duration and structure

(1) In line with the European Credit Transfer and Accumulation System, the individual achievements are assigned with ECTS credits, which reflect the amount of study load of the students. The workload of a fulltime study year corresponds to 60 ECTS credits.

(2) The master's programme SpaceTech lasts 18 months, corresponding to 3 semesters and consists of 90 ECTS credits.

(2) The programme contains lecture series and the Central Case Project (CCP) in an extend of overall 70 ECTS credits and concludes with a written master's thesis, which has to be defended and is assessed with 20 ECTS credits.

(3) The programme is offered in a format adapted to the needs of the participants who are working professionals. The programme consists of modules, classroom sessions and distance learning elements, which benefit from the use of the e-learning platform of TU Graz, and which allow working professionals to participate while continuing to work in their normal jobs. The classroom sessions are taught at TU Graz and at five cooperating European space centres.

§ 3. Language of instruction

(1) Due to its international orientation, the complete programme is conducted in English.

(2) The academic direction can demand proof of sufficient language proficiency of each applicant. This is one of the requirements for admission to the programme, as detailed in § 6.

Programme administration

§ 4. Academic direction

(1) The Vice Rector for Academic Affairs of TU Graz is appointing the programme director, who has to be a qualified member of Graz University of Technology with a teaching qualification in a relevant subject.

(2) The academic direction appoints other employees to academic positions according to the demand.

(3) The Life Long Learning Department of TU Graz is responsible for the administrative management of the programme; the SpaceTech Programme Manager organizes and coordinates the administrative issues.

(4) A Module Management Committee (MMC) will be implemented, consisting of the Module Managers (primary lecturers of the modules/courses) and the academic direction. The objective of the MMC is the optimal harmonisation of the content and coordination of the programme. The Module Managers also act as coaches for the Central Case Project (CCP).

§ 5. Programme costs

(1) In order to run the master's programme in a cost-effective way, a programme fee will be set by the Rectorate by means of a decree following the recommendation of the academic direction and the Life Long Learning unit. The programme fee can be adjusted to budgetary demands when necessary.

(2) Each year a report on the financial conduct of the master's programme must be presented to the Rectorate.

(3) Even for the case that a student receives a recognition of previous studies, parts of a study or lectures, this fact will not reduce the amount of the programme fee.

Admission

§ 6. Admission requirements

(1) The admission requirements for the master's programme "SpaceTech" are as follows:

- Bachelor or Master degree in engineering, natural sciences, economy or law, or a similar academic qualification
- Proven relation to the aerospace sector and typically three years of experience in the aerospace sector or a closely related field
- Proficiency in English

(2) The academic direction or the admission committee can demand proof of sufficient language proficiency (see § 3).

(3) The final decision regarding admission to the programme is made by the academic direction.

§ 7. Application and admission procedure

(1) An application to the programme has to be submitted in written form through a completely filled application form and a Curriculum Vita.

(2) The admission comprises an examination of the application documents and an intake interview. The application form, the application deadline and further information are published on the web site of the TU Graz Life Long Learning department.

The intake interview is conducted by the academic direction, the evaluated criteria include:

- Sufficient academic qualifications
- Proficiency in English
- Clear motivation for entering the programme
- Sufficient relation to the aerospace sector and sufficient experience in that or a closely related field

(3) The admission for a place in a SpaceTech term is granted in writing by the academic direction. Admission as a postgraduate master student is granted by the Rectorate and administered by the Registration Office.

(4) The application to the master's programme does not automatically qualify for participation in the programme. Prerequisite for admission is the successful completion of the admission procedure, which is performed by the programme director. The academic direction evaluates, based on the documents submitted, if the admission requirements defined in the curriculum are met.

§ 8. Places in the programme

(1) A maximum of 18 students can be accommodated per term due to didactic and organisational reasons.

(2) Admission to the master's programme is granted according to the number of places available. Because of the limited number of study places, the applicants will be allocated in the order in which the binding applications were received. The academic direction has the final decision regarding the admission of later ranked or late arrived applications in each particular case.

(3) In the case of too many applications, that positively passed the admissions evaluation, the following criteria have to be taken into consideration for the selection of the applicants: previous education, duration and kind of working experience and a balanced composition of the group with respect to the diversity of their fields of work. Further, a balanced gender ratio of the students and the result of the intake interview has to be taken into account.

Programme structure

§ 9. Lectures

The master's programme consists of the subjects listed in the appendix, that are offered as individual lectures in the form of modules, the Central Case Project (CCP) and the master's thesis.

§ 10. Examinations

(1) The primary lecturer of each module is responsible for the grading of that lecture. He has to define the examination mode (written or oral examination, homework, rating of the participation) at the beginning of the lecture.

(2) In addition to grades that may be earned through class graded exercises, six of the eight modules are each assessed through individual five-hour exams taken via the internet during intersessions. The exam information is made available for a single weekend (48 hours). Once a student opens the exam (this is tracked), it must be returned to the academic direction in digital form within 5 hours. This procedure applies to the following modules:

- Business Engineering
- Space Mission Analysis and Design
- Telecommunications
- Earth Observation
- Navigation
- Human Space Flight

(3) Positively passed examinations are to be assigned with the grades "very good" ("sehr gut", 1), "good" ("gut", 2), "acceptable" ("befriedigend", 3) or "sufficient" ("genügend", 4) and a negative examination is to be assigned with the grade "not sufficient" ("nicht genügend", 5).

(4) The final examination is conducted as oral defence of the master's thesis in front of an examination committee. This examination committee consists of the lecturer of the specific course, and two additional individuals, that are nominated by the academic direction.

(6) In addition to the individual grades of each lectures an overall grade is given. The overall grade has to be "passed" ("bestanden"), if each individual lecture is assessed with a positive grade, otherwise it has to be "not passed" ("nicht bestanden"). The overall grade has to be "passed with distinction" ("mit Auszeichnung bestanden"), if each lecture and the defence of the master's thesis are assessed with the grades "very good" ("sehr gut") or "good" ("gut") and at least half of the lectures feature the grade "very good" ("sehr gut").

(7) Negatively assessed examinations can be repeated up to four (4) times.

(8) The third (3.) and fourth (4.) repetition of the exam have to be performed in front of an examination committee.

§ 11. Accreditation of examinations

Positively assessed examinations of equivalent courses from recognized domestic and foreign post-secondary and extra-university educational institutions can be accredited by the Programme Director upon the filing of a petition by the student.

§ 12. Master's thesis

(1) Participants must write a comprehensive master's thesis.

(2) The content of the master's thesis is oriented towards current studies, analyses and/or developments in space systems and business engineering and can be performed in cooperation with space industries or organizations.

(3) The topic of the master's thesis and its content should be based on a specific aspect of the Central Case Project (CCP) and must be presented in a rough draft to the academic direction for approval prior to beginning the thesis.

(4) Students have a minimum of three (3) months to complete their master's thesis.

(5) Academic supervision of the master's thesis is provided by a faculty member of TU Graz and a coach of the SpaceTech programme.

(6) After completion of the master's thesis, it has to be submitted to the academic direction for assessment.

§ 13. Miscellaneous

(1) An academic advisory board will be established to assist in the evaluation and further development of the master's programme.

Degree granted

§ 14. Establishment of academic success

(1) Academic success is established by means of positive assessed examinations in the individual lectures (see § 10), the positive assessment of the master's thesis (see § 12) and a final examination in front of a committee.

(2) The final examination takes place in front of an examination committee of at least 3 persons, which is nominated by the academic direction. The exam is performed in oral form and deals with the topic of the master's thesis and associated subjects. There is also a defence of the master's thesis.

§ 15. Academic degree

The participant is issued a diploma and the academic degree of "MEng SpaceTech" (short form) and "Master of Engineering in Space Systems and Business Engineering" (long form) is awarded.

Final regulations

§ 16. Validity of the curriculum

The curriculum comes into effect four weeks after been published in the information newsletter "Mitteilungsblatt" of Graz University of Technology.

§ 17. Organizer

The organizer is Graz University of Technology.

Amendment / Appendix

Lectures overview

No.	Module	Lecture	Sem.hr	ECTS
01	PM	Applied Project Management for Space Systems	2	3
02	BE	Business Engineering	5	7
03	SMAD	Space Mission Analysis & Design	4	6
04	TC	Telecommunication	3	5
05	EO	Earth Observation	3	5
06	SE	Systems Engineering	3	5
07	NAV	Navigation	3	5
08	HSF	Human Spaceflight	3	5
09	ISLD	Interpersonal Skills & Leadership Development	6	8
10	ST	Selected Topics on Space Systems Engineering Seminar	3	5
11	CCP	Central Case Project	12	16
12	MT	Master's Thesis	13	20
			60	**90**