

SYLLABUS

STUDY YEAR 2021/2022

Master Programme in Space Science and Technology

Enrollment semester Autumn 2021

DATE

2020-11-10

DECISION MAKER

Dean of the Faculty of Engineering

Programme content and structure

In order to be eligible for the diploma in Master of Science in Space Technology with specializations in Atmospheric and Space Sciences, Space Technology and Instrumentation the student has to obtain 120 ECTS, including courses on the advanced level for at least 90 ECTS and a Master thesis for 30 ECTS. The Program is given in a close collaboration with the leading European universities, space research and industrial organisations. The Programs's structural mobility allows the students to receive knowledge from a number of fundamental academic disciplines within one educational program, i.e. aerospace engineering, atmospheric science, signal processing, space science, space technology and robotics.

Partner universities:

- Luleå University of Technology (LTU), Sweden (coordinator)
- Aalto University, School of Electrical Engineering (Aalto), Finland
- Cranfield University (CU), UK
- Czech Technical University in Prague (CTU), Czech Republic
- Université Toulouse III - Paul Sabatier (UT3), France

The first semester of the Program is common for all students and takes place at LTU, Kiruna Space Campus. During the second semester at LTU the students take courses depending on the specialization. During the second year the students are distributed among the European partner universities, which offer different specializations depending on their respective fields of expertise. The distribution of students is based on their own ranking priorities, merits and place availability.

Specializations at LTU:

- Space Technology and Instrumentation
- Atmospheric and Space Science

Specializations at the partner universities:

- Space Robotics and Automation (Aalto)
- Space Science and Technology (Aalto)
- Space Automation and Control (CTU)
- Dynamics and Control of Systems and Structures (CU)
- Space Technique and Instrumentation (UT3)
- Astrophysics, Space Science and Planetology (UT3)

Swedish for Beginners 3 ECTS is offered for overseas students. The course is not included in the degree, and is taken in addition to the compulsory courses.

During the fourth semester the students perform their Master thesis projects in partner universities, space research and industrial organisations around the world. For admission to the Master thesis at LTU the entry requirements specified in the course syllabus must be completed. An information about the application and admission processes is given and ensured by the responsible department at LTU.

During the summer months, i.e. June-August, the students have a possibility to carry out internships in the research groups at the partner universities, international space research and industrial organisations.

All students that meet the requirements for graduation will receive a diploma of Master of Science with a Major in Space Technology from LTU. Specializations given at LTU are included in the diploma. Recognition of the Program in each partner university is carried out by the respective institutional entities and authorities according to the university procedures in line with the respective national legislations. Courses and diploma requirements for specializations at the partner universities are available at the respective partner universities, <https://spacemaster.eu/>

Credits

120 credits

Degree

- Degree of Master of Science (120 credits) - Major; Space Technology

Specialisations

Specialisation

- Atmospheric and Space Science, research oriented (RYSP)
- Space Technology and Instrumentation (RYIN)

Profile

- RYIN, Dynamics & Control of Systems & Structures, Crainfield
- RYIN, Space Automation and Control, Prag
- RYIN, Space Robotics and Automation, Alto
- RYIN, Space Technique and Instrumentation, Toulouse
- RYIN, Space Technology and Instrumentation, Kiruna
- RYSP, Astrophysics, Space Science and Planetology, Toulouse
- RYSP, Atmospheric and Space Science, Kiruna
- RYSP, Space Science and Technology, Alto

Entry requirements

Successful completion of a basic engineering program or a Bachelor's degree with a minimum of 180 ECTS in the areas of physics (space, plasma, atmospheric, nuclear, particle, fluid dynamics, aerodynamics), space science, planetology, astronomy, atmospheric science, remote sensing, numerical simulations, mechanical engineering, electrical engineering, space engineering, aerospace engineering, robotics, automation, communication, electronics, mechatronics, control theory or equivalent. A minimum of 22.5 ECTS in mathematics at the university level is required.

Good knowledge in English, equivalent to English B/6.

Selection

The selection procedure is based on academic qualifications, quality and quantity aspects

Selection group

Academic: 100%

Compulsory courses

Compulsory courses 60 credits

Course code	Course	Cr	Level	Comment
F7008R	The Solar System	7.5	Avancerad nivå	
P7004R	Master Degree Project	30	Avancerad nivå	
R7017R	Space Physics	7.5	Avancerad nivå	
R7021R	Space Communication	7.5	Avancerad nivå	
R7028R	Spacecraft Systems	7.5	Avancerad nivå	

Course is offered for non-Swedish speakers, not included in the degree 3 credits

Selective space is 3 credits. It is mandatory to select elective courses up to the given number of credits. The given number of credits of elective courses listed must be met for degree.

Course code	Course	Cr	Level	Comment
S0046P	Swedish for International Students 1	3	Grundnivå	Selectable

Profile: RYIN, Dynamics & Control of Systems & Structures, Crainfield

Compulsory courses, 50 Hp within Master thesis 45 Hp and other course 5 Hp

Course code	Course	Cr	Level	Comment
	Space Propulsion, 5 Hp			
	Master thesis, 45 Hp			

Elective courses, 30 Hp, within selective courses 10 Hp of 30 credits

Course code	Course	Cr	Level	Comment
	Aerospace Navigation and Sensors	5		
	Design and Analysis of Composite Structures	5		
	Multivariable Control Systems for Aerospace Applications	5		
	Finite Element Analysis	5		
	Control Systems	5		
	Satellite Attitude Dynamics and Control	5		

Profile: RYIN, Space Automation and Control, Prag
Compulsory courses, 60 Hp within Diploma thesis 30 Hp and other courses 30 credits

Course code	Course	Cr	Level	Comment
	Individual Design Project	8		
	Control Systems for Aircraft and Spacecraft	7		
	Diploma thesis, 30 Hp			
	Space Systems, Modeling and Identification	7		
	Optimal and Robust Control Design	8		

Profile: RYIN, Space Robotics and Automation, Alto
Compulsory courses, 50 Hp within Master thesis 30 Hp and other courses 20 credits

Course code	Course	Cr	Level	Comment
	Embedded Real-Time Systems	5		
	Robotics	5		
	Thesis Writing for Engineers	3		
	Master thesis, 30 Hp			
	Modelling, Estimation and Dynamic Systems	5		
	Finnish 1A	2		

Elective courses, 35 Hp within selective courses choose 10 credits

Course code	Course	Cr	Level	Comment
	Stochastics and Estimation, 5 Hp			
	Mechatronics Basics, 5 Hp			
	Micro and Nano Robotics, 5 Hp			
	Robotic manipulation, 5 Hp	5		
	Computer Vision, 5 Hp	5		
	Satellite Systems, 5 Hp			
	Autonomous Mobile Robots, 5 Hp			

Elective courses in addition to the requirements for the degree, 1-6 Hp

Course code	Course	Cr	Level	Comment
	Get to Know Finland, 1 Hp			
	Reinforcement Learning, 5 Hp			

Profile: RYIN, Space Technique and Instrumentation, Toulouse

Compulsory courses, 60 Hp, within Master Thesis 30 Hp and other courses 30 credits

Course code	Course	Cr	Level	Comment
	Data analysis and programming	9		
	Scientific English	3		
	Practical assignments, Master Thesis, 9 Hp			
	Space industry and engineering	3		
	Practical assignments, Master Thesis, 9 Hp			
	Space systems and technology	9		
	Space sciences	6		

Profile: RYIN, Space Technology and Instrumentation, Kiruna

Elective courses 30 credits

Selective space is 30 credits. It is mandatory to select elective courses up to the given number of credits. The given number of credits of elective courses listed must be met for degree.

Course code	Course	Cr	Level	Comment
P7005R	Space Engineering Project 1	7.5	Avancerad nivå	Selectable
P7006R	Space Engineering Project 2	7.5	Avancerad nivå	Selectable
R7007E	Special Studies in Space Engineering	7.5	Avancerad nivå	Selectable
R7011R	Image Processing with Space Applications	7.5	Avancerad nivå	Selectable
R7012R	Remote Sensing	7.5	Avancerad nivå	Selectable
R7018R	Spacecraft on board datahandling	7.5	Avancerad nivå	Selectable
R7025R	Orbit and Attitude Dynamics	7.5	Avancerad nivå	Selectable
R7026R	Spacecraft Control	7.5	Avancerad nivå	Selectable
R7030R	Spacecraft Guidance, Navigation and Control	7.5	Avancerad nivå	Selectable

Profile: RYSP, Astrophysics, Space Science and Planetology, Toulouse

Compulsory courses, 54 Hp, within courses and Master Thesis 30 credits

Course code	Course	Cr	Level	Comment
	Scientific English, 3 Hp			
	Physics and astrophysics, 15 Hp			
	Numerical simulations and observations (astrophysics), Master thesis	3		
	Instrumentation, data analysis, space mechanics and engineering, 6 Hp			
	Internship, Master thesis	27		

Elective courses (three course), 21 Hp varav valbart 6 Hp

Course code	Course	Cr	Level	Comment
	Interstellar medium, 2 Hp			
	Evolution of Telluric planets, 2 Hp			
	Cosmology and galactic physics, 2 Hp			
	Planet-environment interactions, 2 Hp			
	Planetary surfaces and global cycles, 2 Hp			
	Star and planet seismology, 2 Hp			
	Compact objects and accretion, 2 Hp			

Profile: RYSP, Atmospheric and Space Science, Kiruna

Elective courses 30 credits

Selective space is 30 credits. It is mandatory to select elective courses up to the given number of credits. The given number of credits of elective courses listed must be met for degree.

Course code	Course	Cr	Level	Comment
F7001E	Radiative transfer	7.5	Avancerad nivå	Selectable
F7002E	Atmospheric dynamics and climate	7.5	Avancerad nivå	Selectable
F7012R	Special Studies in Space and Atmospheric Science	7.5	Avancerad nivå	Selectable
F7015R	Spectroscopy for planetary exploration	7.5	Avancerad nivå	Selectable
P7005R	Space Engineering Project 1	7.5	Avancerad nivå	Selectable
P7006R	Space Engineering Project 2	7.5	Avancerad nivå	Selectable
R7011R	Image Processing with Space Applications	7.5	Avancerad nivå	Selectable
R7012R	Remote Sensing	7.5	Avancerad nivå	Selectable
R7018R	Spacecraft on board datahandling	7.5	Avancerad nivå	Selectable

Profile: RYSP, Space Science and Technology, Alto

Compulsory courses, 50 Hp, within Master thesis 30 Hp and other courses 20 credits

Course code	Course	Cr	Level	Comment
	Microwave Earth Observation Instrumentation	5		
	Master thesis, 30 Hp			
	Finnish 1A	2		
	Thesis Writing for Engineers	3		
	Space Instrumentation	5		
	Radio Astronomy	5		

Elective courses, 40 Hp, within selective courses choose 10 credits

Course code	Course	Cr	Level	Comment
	Mechatronics Basics, 5 Hp	5		
	Micro and Nano Robotics, 5 Hp	5		
	Computer Vision, 5 Hp			
	Stochastics and Estimation, 5 Hp			
	Satellite Systems, 5 Hp			
	Autonomous Mobile Robots, 5 Hp			
	Robotic manipulation, 5 Hp			
	Introduction to Space, 5 Hp			

elective courses in addition to the requirements for the degree, 1-6 Hp

Course code	Course	Cr	Level	Comment
	Get to Know Finland 1 Hp			
	Reinforcement Learning, 5 Hp			

Specialisation: Atmospheric and Space Science, research oriented (RYSP)

Compulsory courses 22.5 credits

Course code	Course	Cr	Level	Comment
F7004R	Atmospheric Physics	7.5	Avancerad nivå	
F7014R	Polar Atmosphere	7.5	Avancerad nivå	
R7013R	Space Instruments	7.5	Avancerad nivå	

Optional courses 37.5 credits

Selective space is 37.5 credits. It is mandatory to select elective courses up to the given number of credits. The given number of credits of elective courses listed must be met for degree.

Course code	Course	Cr	Level	Comment
E7003R	Electronics in Space	7.5	Avancerad nivå	Selectable
F7001E	Radiative transfer	7.5	Avancerad nivå	Selectable
F7002E	Atmospheric dynamics and climate	7.5	Avancerad nivå	Selectable
F7012R	Special Studies in Space and Atmospheric Science	7.5	Avancerad nivå	Selectable
F7015R	Spectroscopy for planetary exploration	7.5	Avancerad nivå	Selectable
F7016R	Photochemistry of Earth and Planetary Atmospheres	7.5	Avancerad nivå	Selectable
F7017R	Big Data from Space for Planetary Studies	7.5	Avancerad nivå	Selectable
P7005R	Space Engineering Project 1	7.5	Avancerad nivå	Selectable
P7006R	Space Engineering Project 2	7.5	Avancerad nivå	Selectable
R7011R	Image Processing with Space Applications	7.5	Avancerad nivå	Selectable
R7012R	Remote Sensing	7.5	Avancerad nivå	Selectable
R7018R	Spacecraft on board datahandling	7.5	Avancerad nivå	Selectable

Specialisation: Space Technology and Instrumentation (RYIN)

Compulsory courses 15 credits

Course code	Course	Cr	Level	Comment
E7003R	Electronics in Space	7.5	Avancerad nivå	
R7013R	Space Instruments	7.5	Avancerad nivå	

Optional courses 37.5 credits

Selective space is 37.5 credits. It is mandatory to select elective courses up to the given number of credits. The given number of credits of elective courses listed must be met for degree.

Course code	Course	Cr	Level	Comment
D0001R	Microcomputer engineering with space applications	7.5	Grundnivå	Selectable
F7014R	Polar Atmosphere	7.5	Avancerad nivå	Selectable
P7005R	Space Engineering Project 1	7.5	Avancerad nivå	Selectable
P7006R	Space Engineering Project 2	7.5	Avancerad nivå	Selectable
R7004R	Spacecraft Environment Interactions	7.5	Avancerad nivå	Selectable
R7007E	Special Studies in Space Engineering	7.5	Avancerad nivå	Selectable
R7011R	Image Processing with Space Applications	7.5	Avancerad nivå	Selectable
R7012R	Remote Sensing	7.5	Avancerad nivå	Selectable
R7018R	Spacecraft on board datahandling	7.5	Avancerad nivå	Selectable
R7023R	Propulsion with space applications	7.5	Avancerad nivå	Selectable
R7025R	Orbit and Attitude Dynamics	7.5	Avancerad nivå	Selectable
R7026R	Spacecraft Control	7.5	Avancerad nivå	Selectable

Study schedule

Year of study 1 Enrollment semester Autumn 2021, Is offered in 2021/2022

Study-period	Course code	Course	Cr	Comment
1	F7008R	The Solar System	7.5	
1	R7028R	Spacecraft Systems	7.5	
1	S0046P	Swedish for International Students 1	3	Selectable
2	R7017R	Space Physics	7.5	
2	R7021R	Space Communication	7.5	

Year of study 2 Enrollment semester Autumn 2021, Is offered in 2022/2023, planned study schedule

Study-period	Course code	Course	Cr	Comment
3-4	P7004R	Master Degree Project	30	Entry requirements

Profile: RYIN, Space Technology and Instrumentation, Kiruna

Year of study 2 Enrollment semester Autumn 2021, Is offered in 2022/2023, planned study schedule

Study-period	Course code	Course	Cr	Comment
1	P7005R	Space Engineering Project 1	7.5	Selectable
1	P7006R	Space Engineering Project 2	7.5	Selectable
1	R7007E	Special Studies in Space Engineering	7.5	Selectable
1	R7018R	Spacecraft on board datahandling	7.5	Selectable
1	R7025R	Orbit and Attitude Dynamics	7.5	Selectable
2	P7005R	Space Engineering Project 1	7.5	Selectable
2	P7006R	Space Engineering Project 2	7.5	Selectable
2	R7007E	Special Studies in Space Engineering	7.5	Selectable

2	R7011R	Image Processing with Space Applications	7.5	Selectable
2	R7012R	Remote Sensing	7.5	Selectable
2	R7026R	Spacecraft Control	7.5	Selectable
2	R7030R	Spacecraft Guidance, Navigation and Control	7.5	Selectable

Profile: RYSP, Atmospheric and Space Science, Kiruna

Year of study 2 Enrollment semester Autumn 2021, Is offered in 2022/2023, planned study schedule

Study-period	Course code	Course	Cr	Comment
1	F7001E	Radiative transfer	7.5	Selectable
1	F7012R	Special Studies in Space and Atmospheric Science	7.5	Selectable
1	F7015R	Spectroscopy for planetary exploration	7.5	Selectable
1	P7005R	Space Engineering Project 1	7.5	Selectable
1	P7006R	Space Engineering Project 2	7.5	Selectable
1	R7018R	Spacecraft on board datahandling	7.5	Selectable
2	F7002E	Atmospheric dynamics and climate	7.5	Selectable
2	F7012R	Special Studies in Space and Atmospheric Science	7.5	Selectable
2	P7005R	Space Engineering Project 1	7.5	Selectable
2	P7006R	Space Engineering Project 2	7.5	Selectable
2	R7011R	Image Processing with Space Applications	7.5	Selectable
2	R7012R	Remote Sensing	7.5	Selectable

Profile: RYSP, Space Science and Technology, Alto

Year of study 2 Enrollment semester Autumn 2021, Is offered in 2022/2023, planned study schedule

Study-period	Course code	Course	Cr	Comment
1		Space Instrumentation	5	
1		Microwave Earth Observation Instrumentation	5	
2		Radio Astronomy	5	

2		Finnish 1A	2	
2		Thesis Writing for Engineers	3	
3-4		Master thesis, 30 Hp		

Specialisation: Atmospheric and Space Science, research oriented (RYSP)

**Year of study 1 Enrollment semester Autumn 2021, Is offered in
2021/2022**

Study-period	Course code	Course	Cr	Comment
3	F7004R	Atmospheric Physics	7.5	
3	R7013R	Space Instruments	7.5	
4	E7003R	Electronics in Space	7.5	Selectable
4	F7001E	Radiative transfer	7.5	Selectable
4	F7014R	Polar Atmosphere	7.5	
4	F7015R	Spectroscopy for planetary exploration	7.5	Selectable
4	P7005R	Space Engineering Project 1	7.5	Selectable

Specialisation: Space Technology and Instrumentation (RYIN)

**Year of study 1 Enrollment semester Autumn 2021, Is offered in
2021/2022**

Study-period	Course code	Course	Cr	Comment
3	R7004R	Spacecraft Environment Interactions	7.5	Selectable
3	R7013R	Space Instruments	7.5	
3	R7023R	Propulsion with space applications	7.5	Selectable
4	D0001R	Microcomputer engineering with space applications	7.5	Selectable
4	E7003R	Electronics in Space	7.5	
4	F7014R	Polar Atmosphere	7.5	Selectable

4	P7005R	Space Engineering Project 1	7.5	Selectable
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