

SYLLABUS

STUDY YEAR 2024/2025

Master Programme in Space Science and Technology

Enrollment semester Autumn 2024

DATE

2023-10-12

REFERENCE NO.

LTU-4268-2023

DECISION MAKER

Dean of the Faculty of Science and Technology

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)
- Small Satellites and Space Instrumentation (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 international 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

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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/>

Good knowledge in English, equivalent to English 6.

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, Cranfield
- RYIN, Space Automation and Control, Prague
- RYIN, Space Robotics and Automation, Helsinki
- 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

Entry requirements

Academic degree with a minimum of 180 higher education credits 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 credits in mathematics at the university level is required.

Good knowledge in English, equivalent to English 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	Master's level	
P7004R	Master Degree Project	30	Master's level	
R7017R	Space Physics	7.5	Master's level	
R7021R	Space Communication	7.5	Master's level	
R7028R	Spacecraft Systems	7.5	Master's level	

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	Bachelor's level	Selectable

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

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

Course code	Course	Cr	Level	Comment
	Space Populsion, 5 Credits			
	Master thesis, 45 Credits			

Elective courses, within selective courses 10 credits of 35 credits

Course code	Course	Cr	Level	Comment
	Advanced Composite Analysis and Impact 5 Credits	5		
	Spacecraft Attitude Dynamics and Control 5 Credits	5		
	Finite Element Methods 5 Credits	5		
	Space Communications 5 Credits	5		

Course code	Course	Cr	Level	Comment
	Aerospace Navigation and Sensors 5 Credits	5		
	Guidance Navigation and Control of Space Systems 5 Credits	5		
	Mathematics and Programming for Astrodynamics and Trajectory Design 5 Credits	5		

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

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

Profile: RYIN, Space Robotics and Automation, Helsinki
Compulsory courses, 47 Credits within Master thesis 30 credits and other courses 17 credits

Course code	Course	Cr	Level	Comment
	Embedded Real-Time Systems 5 Credits	5		
	Robotics 5 Credits	5		
	Master thesis, 30 Credits			
	Modelling, Estimation and Dynamic Systems 5 Credits	5		
	Master's Thesis Process 2 Credits	2		

Elective courses, 55 Credits, of which optional space 10 credits

Course code	Course	Cr	Level	Comment
	Micro and Nano Robotics, 5 Credits			
	Mechatronics Basics, 5 Credits			
	Basics of Sensor Fusion, 5 Credits			
	Space Instrumentation 5 Credits			
	Reinforcement Learning, 5 Credits			
	Computer Vision, 5 Credits	5		
	Robotic manipulation, 5 Credits	5		
	Satellite Systems, 5 Credits			
	Autonomous Mobile Robots, 5 Credits			
	Introduction to Space 5 Credits			
	Space Physics 5 Credits			

Finnish studies, choose among following courses 3 credits

Course code	Course	Cr	Level	Comment
	Get to Know Finland, 1 Credit			
	Finnish 1, 3 Credits	3		
	Survival Finnish 2, 1 Credit			
	Survival Finnish 1, 1 Credit			

Profile: RYIN, Space Technique and Instrumentation, Toulouse

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

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

Course code	Course	Cr	Level	Comment
	Space industry and engineering 3 Credits	3		
	Practical assignments, Master Thesis, 21 Credits			

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	Master's level	Selectable
P7006R	Space Engineering Project 2	7.5	Master's level	Selectable
R7007E	Special Studies in Space Engineering	7.5	Master's level	Selectable
R7011R	Image Processing with Space Applications	7.5	Master's level	Selectable
R7012R	Remote Sensing	7.5	Master's level	Selectable
R7018R	Spacecraft on board datahandling	7.5	Master's level	Selectable
R7025R	Orbit and Attitude Dynamics	7.5	Master's level	Selectable
R7026R	Spacecraft Control	7.5	Master's level	Selectable
R7030R	Spacecraft Guidance, Navigation and Control	7.5	Master's level	Selectable

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

Compulsory course, Master thesis 27 credits

Course code	Course	Cr	Level	Comment
	Internship, Master thesis 27 Credits	27		

Elective courses - choose of 3 courses

*) **Astrophysics, 18 Credits - Choose 3 option from below:**

- Interactions of planets with their environment.
- The interstellar medium and stellar formation.
- Stellar and planetary seismology.
- Compact objects and accretion.

- Cosmology and galaxy physics.

Course code	Course	Cr	Level	Comment
	Astrophysics - 3 modules to choose, each 6 Credits			
	Transversal courses 9 Credits			
	Numerical simulation and data processing 3 Credits			
	Physics and astrophysics, 15 Credits			

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
F7011R	Climate Physics	7.5	Master's level	Selectable
F7012R	Special Studies in Space and Atmospheric Science	7.5	Master's level	Selectable
F7019R	Advanced Radiative Transfer	7.5	Master's level	Selectable
P7005R	Space Engineering Project 1	7.5	Master's level	Selectable
P7006R	Space Engineering Project 2	7.5	Master's level	Selectable
R7011R	Image Processing with Space Applications	7.5	Master's level	Selectable
R7012R	Remote Sensing	7.5	Master's level	Selectable
R7018R	Spacecraft on board datahandling	7.5	Master's level	Selectable

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

Compulsory courses 22.5 credits

Course code	Course	Cr	Level	Comment
F7004R	Atmospheric Physics	7.5	Master's level	
F7014R	Polar Atmosphere	7.5	Master's level	
R7013R	Space Instruments	7.5	Master's level	

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	Master's level	Selectable
F7002E	Atmospheric dynamics and climate	7.5	Master's level	Selectable
F7011R	Climate Physics	7.5	Master's level	Selectable
F7012R	Special Studies in Space and Atmospheric Science	7.5	Master's level	Selectable
F7018R	Introduction to Spectroscopy and Radiative transfer	7.5	Master's level	Selectable
P7005R	Space Engineering Project 1	7.5	Master's level	Selectable
P7006R	Space Engineering Project 2	7.5	Master's level	Selectable
R7011R	Image Processing with Space Applications	7.5	Master's level	Selectable
R7012R	Remote Sensing	7.5	Master's level	Selectable
R7018R	Spacecraft on board datahandling	7.5	Master's level	Selectable

Specialisation: Space Technology and Instrumentation (RYIN)

Compulsory courses 15 credits

Course code	Course	Cr	Level	Comment
E7003R	Electronics in Space	7.5	Master's level	
R7013R	Space Instruments	7.5	Master's level	

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
F7004R	Atmospheric Physics	7.5	Master's level	Selectable
F7014R	Polar Atmosphere	7.5	Master's level	Selectable
F7018R	Introduction to Spectroscopy and Radiative transfer	7.5	Master's level	Selectable

Course code	Course	Cr	Level	Comment
P7005R	Space Engineering Project 1	7.5	Master's level	Selectable
P7006R	Space Engineering Project 2	7.5	Master's level	Selectable
R0010R	Onboard computers and onboard software	7.5	Bachelor's level	Selectable
R7004R	Spacecraft Environment Interactions	7.5	Master's level	Selectable
R7007E	Special Studies in Space Engineering	7.5	Master's level	Selectable
R7011R	Image Processing with Space Applications	7.5	Master's level	Selectable
R7012R	Remote Sensing	7.5	Master's level	Selectable
R7018R	Spacecraft on board datahandling	7.5	Master's level	Selectable
R7023R	Propulsion with space applications	7.5	Master's level	Selectable
R7025R	Orbit and Attitude Dynamics	7.5	Master's level	Selectable
R7026R	Spacecraft Control	7.5	Master's level	Selectable

Study schedule

Year of study 1 Enrollment semester Autumn 2024, Is offered in 2024/2025

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 2024, Is offered in 2025/2026, 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 2024, Is offered in 2025/2026, 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 2024, Is offered in 2025/2026, planned study schedule

Study-period	Course code	Course	Cr	Comment
1	F7012R	Special Studies in Space and Atmospheric Science	7.5	Selectable
1	F7019R	Advanced Radiative Transfer	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	F7011R	Climate Physics	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

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

Year of study 1 Enrollment semester Autumn 2024, Is offered in 2024/2025

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	F7014R	Polar Atmosphere	7.5	
4	F7018R	Introduction to Spectroscopy and Radiative transfer	7.5	Selectable
4	P7005R	Space Engineering Project 1	7.5	Selectable

(RYIN)

Year of study 1 Enrollment semester Autumn 2024, Is offered in 2024/2025

Study-period	Course code	Course	Cr	Comment
3	F7004R	Atmospheric Physics	7.5	Selectable
3	R7004R	Spacecraft Environment Interactions	7.5	Selectable
3	R7013R	Space Instruments	7.5	
3	R7023R	Propulsion with space applications	7.5	Selectable
4	E7003R	Electronics in Space	7.5	
4	F7014R	Polar Atmosphere	7.5	Selectable
4	F7018R	Introduction to Spectroscopy and Radiative transfer	7.5	Selectable
4	P7005R	Space Engineering Project 1	7.5	Selectable
4	R0010R	Onboard computers and onboard software	7.5	Selectable