

Laurea Magistrale (Master of Science) Space Engineering - Ingegneria Spaziale

Presentation of the Study Programme

Lorenzo Dozio 26 may 2021

Outline

- 1. Preliminaries
- 2. Learning goals and professional opportunities
- 3. Admission (access requirements)
- 4. General organization of the Study Programme
- 5. Study plans (rules/constraints and typologies)
- 6. Educational Profiles (suggested educational pathways)
- 7. Master's Thesis and final exam
- 8. Additional activities and international mobility
- 9. Department of Aerospace Science and Technology

POLITECNICO DI MILANO

Strengths of our academic excellence:

- a high rate of employment among graduates
- a first-rate research attracting European funding
- a technology transfer activity among the best in Europe
- a role increasingly oriented towards social responsibility
- a prestigious international profile



16° ENGINEERING	11° ARCHITECTURE	6° DESIGN	149° OVERALL
QS RANKING 2020	QS RANKING 2020	QS RANKING 2020	+ 21 IN THE LAST 2 YEARS
1.400	1.100	260	1.200
PROFESSORS & RESEARCHERS	RESEARCH ASSISTANTS	INTERNATIONAL FACULTY (2017)	ADMINISTRATIVE STAFF
45.000	6.000	25	45
STUDENTS	FOREIGN STUDENTS	BS PROGRAMS	MS PROGRAMS

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12 Departments

Aerospace Science and Technology

Architecture and Urban Studies

Architecture, Built Environment and Construction Engineering

Chemistry, Materials and Chemical Engineering

Civil and Environmental Engineering

Design

Electronics, Information and Bioengineering

Energy

Management, Economics and Industrial Engineering

Mathematics

Mechanics

Physics





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4 Schools

- School of Architecture, Urban Planning, Construction Engineering
- School of Design
- School of Civil, Environment and Land Management Engineering
- School of Industrial and Information Engineering



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Academic calendar

Two semesters:

- 1. mid September December
- 2. end of February beginning of June

Exam sessions:

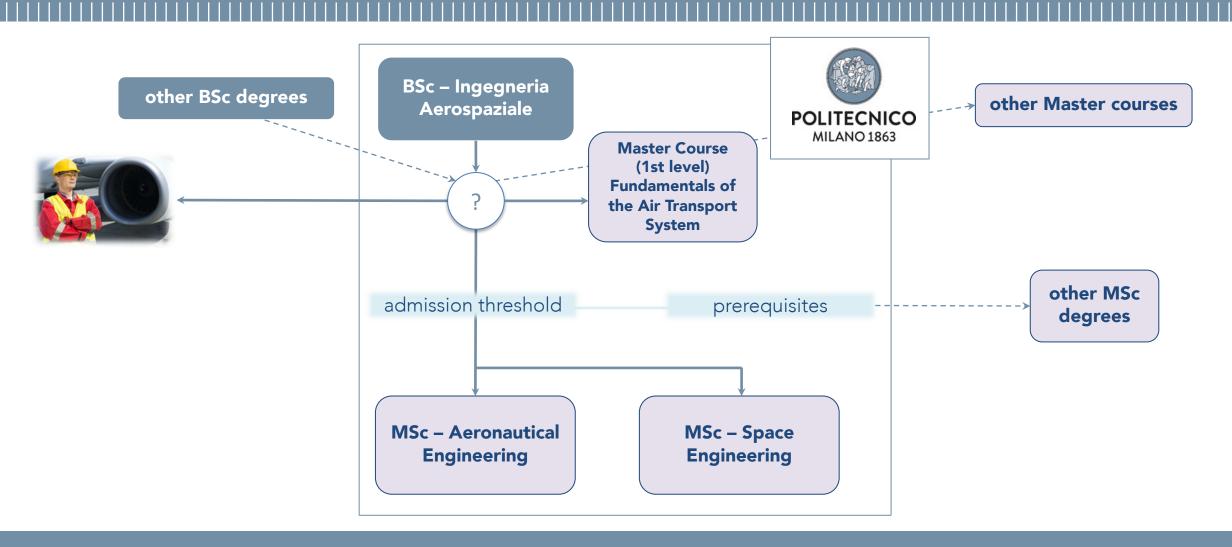
- 1. winter sessions (two calls– January and February)
- 2. summer session (two calls June and July)
- 3. late summer session (one call September)

Graduation days:

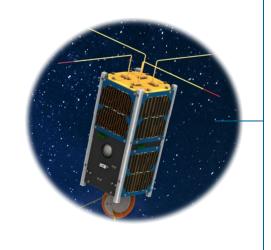
four per year (April, July, October, December)



Aerospace Engineering – Educational offer @Polimi



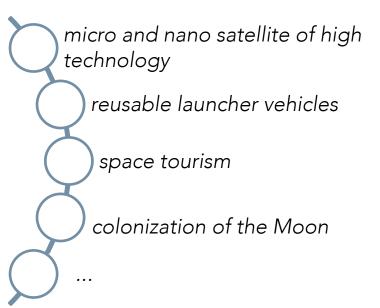
The future of aerospace



In the coming years, the aerospace sector will be faced with new and important challenges, which will require professionals with advanced knowledge and specific skills, able to successfully respond to technological problems of the present and future.

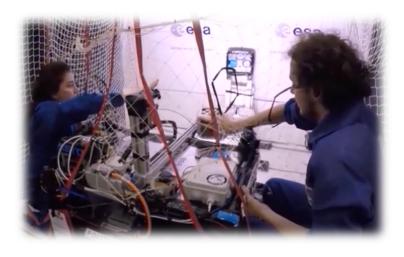
Space technologies and services have become an integral and indispensable part of the modern economy and global society.

NEW SPACE ECONOMY: entry of private companies into a sector that was traditionally the preserve of public institutions and bodies.



Learning goals

The general learning objective is to train engineers with a high technical/scientific preparation, qualified to carry out and manage activities connected with research and design in the space sector. Master's degree graduates in Space Engineering have the skills to fully develop activities related to the design, analysis and verification of a space mission. In these areas are highlighted the skills for specialists in: mission analysis, thermo-structural design of space systems, design of propulsion and energy subsystems, orbital and attitude control, operations and communications with the Earth station, integration of space systems and post-launch operations. The knowledge imparted in the various courses is offered in an educational context which, in addition to its acquisition, aims to develop the student's capacity for interdisciplinary integration and ability to tackle new and complex problems in a scientifically rigorous manner.



These elements are considered essential in order to meet the specific learning and **professionalisation/specialisation objectives** that students will set themselves by choosing the proposed courses, giving priority to disciplinary aspects (**specialized courses**) or multidisciplinary aspects (**complementary courses**), thus optimally matching their interests/aptitudes with the skills profiles required by the labour market.

Professional opportunities



space and aeronautical industries for the design, production and operation of spacecraft (aircraft) and their components

companies operating in aerospace related businesses (industrial partners, subcontractors, engineering consultancy companies)

space agencies and space research centres;

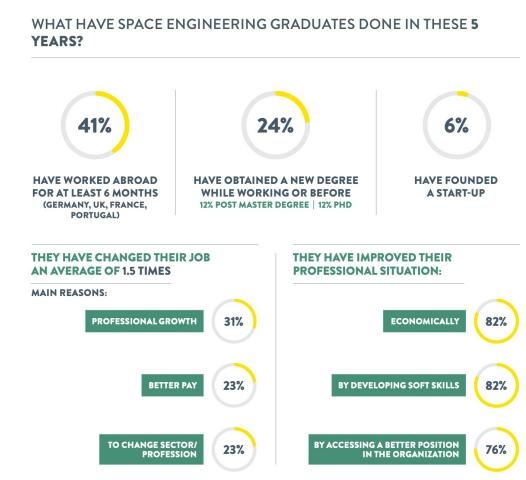
industries designing and producing machinery, equipment and systems involving advanced methodologies and technologies

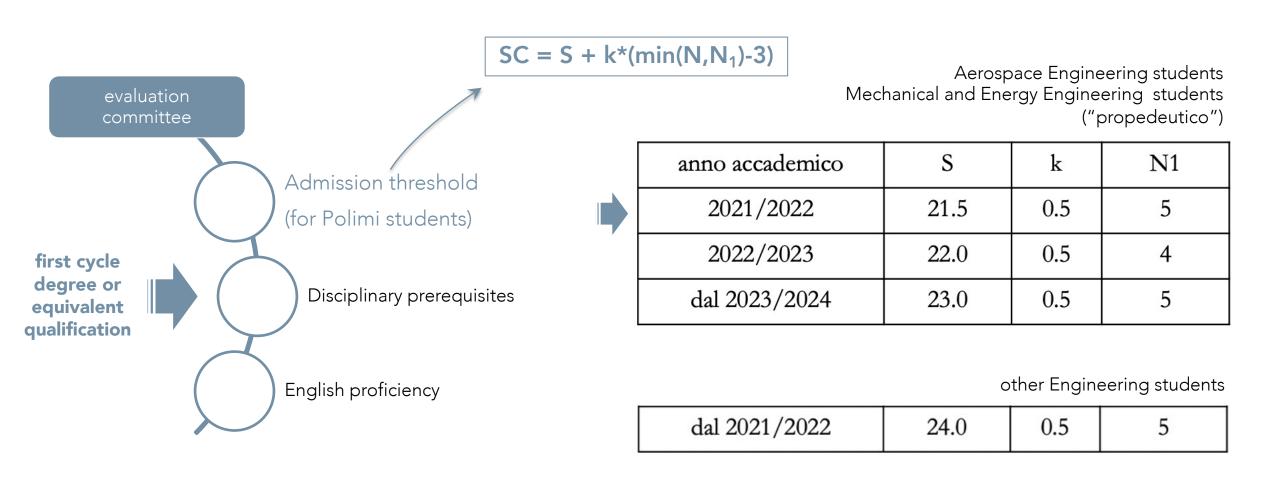
Professional opportunities – Graduate employment

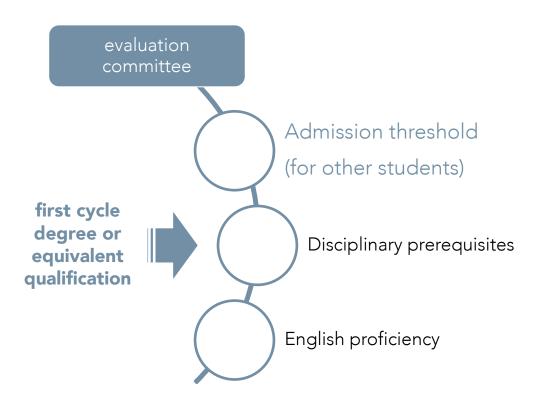


Professional opportunities – Graduate employment









Candidates with a BSc issued by an Italian University

Threshold

From Aerospace Eng.

Final average in the $BSc \ge 25/30$

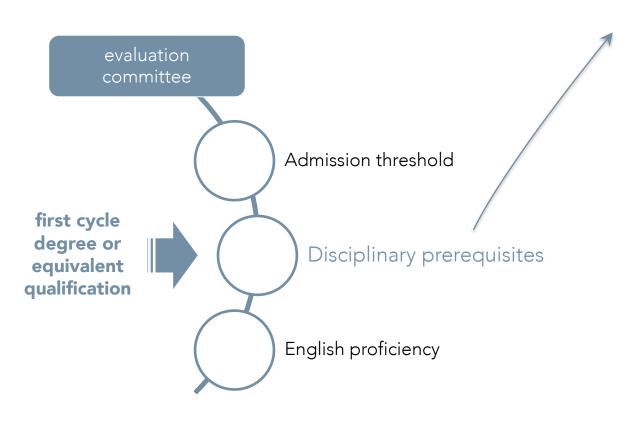
From other BSc

Final average in the BSc > 26/30

Candidates with a BSc issued by a foreign University

Threshold

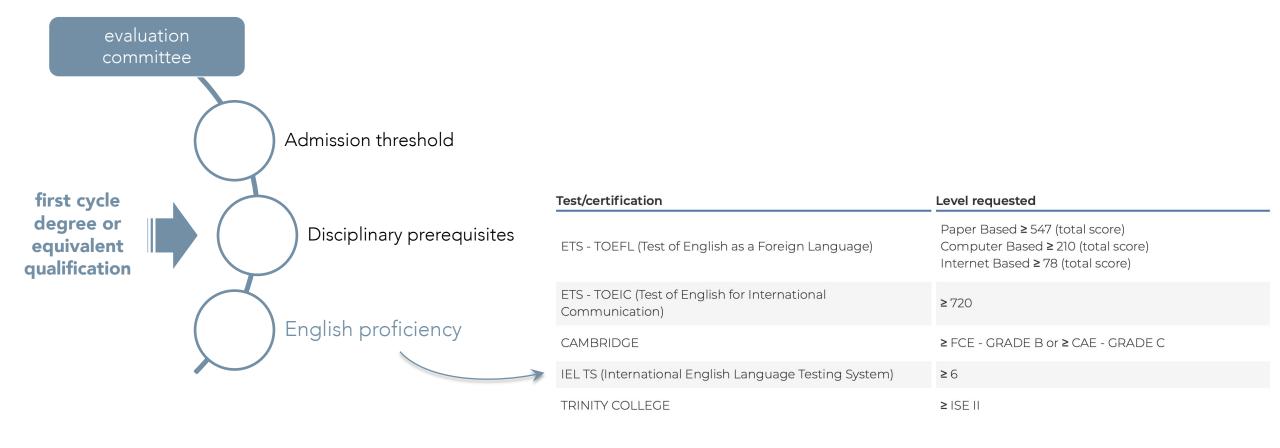
weighted combination of the final mark got at the BSc degree and the ranking of the University



All Polimi graduates in Aerospace Engineering, Mechanical Engineering ("propedeutico") and Energy Engineering ("propedeutico") are admitted without curricular integrations.

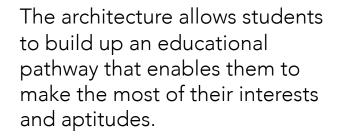
All other applicants with a first-level degree in an Engineering degree class (L-7, L-8 or L-9), in order to be admitted without curricular integrations, must have obtained a number of credits (CFU) greater than or equal to that shown in the table in each of the indicated subject areas.

Ambito scientifico-disciplinare	CFU
Meccanica dei solidi (ING-IND/04, ICAR/08)	5
Meccanica teorica/applicata (MAT/07, ING-IND/13)	5
Analisi numerica (MAT/08)	5
Fisica tecnica/sistemi energetici (ING-IND/09, ING-IND/10)	5



General organization

Educational activities	semester	credits	year
5 mandatory core courses	1,2	48	1
2 elective courses (complementary)	2	12	
Elective courses (specialized/complementary)	1,2	40	2
Thesis and final exam	1,2	20	





There is a wide and diversified choice of subjects, particularly in the second year of the course, so that most of the requirements can be met within the proposals contained in the Study Programme, without the need for an autonomous study plan (which is still possible).

General organization (first year)

5 mandatory core courses	1,2	48
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Educational activities

TYPE B: specialized courses – focused on aerospace subjects (flight mechanics, aerostructures, propulsion, aerodynamics, ...)

TYPE C: complementary courses – related to (but not directly focused on) aerospace subjects (e.g., mechanical systems, control systems, energy systems, management, ...)

TYPE -: other courses/activities

Type	Course	Lang	Sem	CFU
В	ORBITAL MECHANICS	EN	1	10.0
В	SPACECRAFT ATTITUDE DYNAMICS	EN	1	10.0
В	SPACE STRUCTURES	EN	1	10.0
В	SPACE PROPULSION	EN	2	10.0
В	SPACE SYSTEMS ENGINEERING AND OPERATIONS	EN	2	8.0

General organization (first year)

2 elective courses (complementary) 2 12

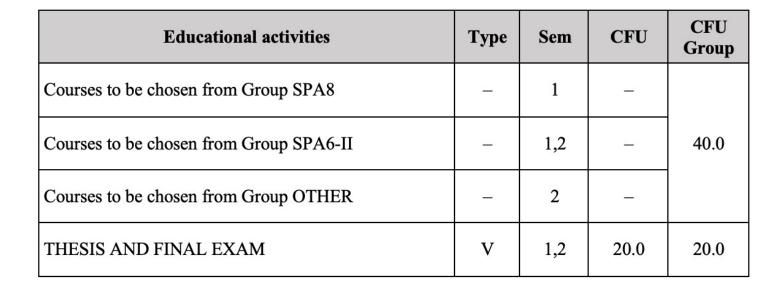


Group SPA6

Туре	Course	Lang	Sem	CFU
C	GESTIONE DEI PROGETTI AEROSPAZIALI	IT	2	6.0
С	HEAT TRANSFER AND THERMAL ANALYSIS	EN	2	6.0
-	OPERATIONS RESEARCH	EN	2	6.0
-	SPACE PHYSICS	EN	2	6.0
С	ELECTROMAGNETICS AND SIGNAL PROCESSING FOR SPACEBORNE APPLICATIONS	EN	2	6.0

General organization (second year)

Elective courses (specialized/complementary)	1,2	40	2
Thesis and final exam	1,2	20	



General organization (second year) – Group SPA8

Туре	Course	Lang	Sem	CFU
В	AEROSPACE TECHNOLOGIES AND MATERIALS	EN	1	8.0
В	AEROTHERMODYNAMICS	EN	1	8.0
В	ESTIMATION AND LEARNING IN AEROSPACE	EN	1	8.0
В	LAUNCH SYSTEMS	EN	1	8.0 [1.5 @]
В	MODELING AND SIMULATION OF AEROSPACE SYSTEMS	EN	1	8.0
В	PAYLOAD DESIGN	EN	1	8.0
В	APPLIED SPACE MISSION ANALYSIS AND DESIGN		1	8.0 [4.0 @]
С	REMOTE SENSING FOR EARTH OBSERVATION AND SURVEILLANCE	EN	1	8.0
C	TECNOLOGIE DEI SISTEMI DI CONTROLLO PER L'AERONAUTICA	IT	1	8.0
В	SPACECRAFT GUIDANCE AND NAVIGATION	EN	1	8.0

General organization (second year) – Group SPA6-II

Type	Course	Lang	Sem	CFU
В	ANALYSIS AND TESTING OF SPACE STRUCTURES	EN	1	6.0
С	HIGH-TECH STARTUPS: CREATING AND SCALING UP I	EN	1	6.0 [6.0 @]
В	HUMAN SPACEFLIGHT AND OPERATIONS Course with limited number of students	EN	1	6.0 [4.0 di]
С	SATELLITE COMMUNICATION AND POSITIONING SYSTEMS	EN	1	6.0
В	COMBUSTION IN THERMOCHEMICAL PROPULSION B	EN	2	6.0
C	GESTIONE DEI PROGETTI AEROSPAZIALI	IT	2	6.0
В	METODI AVANZATI PER LA PROGETTAZIONE DI STRUTTURE AEROSPAZIALI	IT	2	6.0 [3.0 di]
В	MULTIBODY SYSTEM DYNAMICS	EN	2	6.0
_	OPERATIONS RESEARCH	EN	2	6.0
_	SPACE PHYSICS	EN	2	6.0

General organization (second year) – Group OTHER

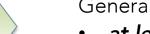
Туре	Course	Lang	Sem	CFU
	INTRODUCTION TO RESEARCH*	EN	2	2.0 [2.0 di]
-	COMMUNICATION AND ARGUMENTATION B	EN	2	3.0 [3.0 di]
_	CRITICAL THINKING	EN	2	3.0 [3.0 di]
-	EMERGING TECHNOLOGIES AND SOCIETAL CHALLENGES	EN	2	3.0 [3.0 @i]
_	ETHICS FOR TECHNOLOGY B	EN	2	3.0 [3.0 di]
_	SOCIAL HISTORY OF TECHNOLOGY AND DIGITAL INFRASTRUCTURES	EN	2	3.0 [3.0 di]
В	TECHNICAL AND SCIENTIFIC COMMUNICATION*	EN	2	2.0 [2.0 di]
_	THE SOCIAL SHAPING OF TECHNOLOGY	EN	2	3.0 [3.0 di]

Study plans – general constraints

The study plan is approved in advance if it is completed in accordance with the constraints set out on the right.



Compliance with these constraints is reflected in the compilation of a plan conforming to one of the schemes belonging to the standard typologies (A, B, C and D) described in the following.



General constraints:

- at least 66 credits in educational activities of type B (specialized aerospace courses)
- at least 12 credits in educational activities of type C (complementary courses)

The organisation of the Study Programme is such that the study plan may be approved in advance if **the first year of the course reflects the general organisation of the degree course** and if in the second year the choice of subjects complies with the following constraints:

- courses from the Group OTHER: min 0 max 5 credits
- courses from the Group SPA8: min 16 max 40 credits
- courses from the Group SPA6-II: min 0 max 24 credits
- PAYLOAD DESIGN or APPLIED SPACE MISSION ANALYSIS AND DESIGN

Study plans – typologies (approval in advance)

First year

5 mandatory core courses (48 credits) 2 courses from Group SPA6 (12 credits)

Typology A	Typology B	Typology C	Typology D
Year 2: 3 courses from Group SPA8 2 courses from Group SPA6-II 2 courses from Group OTHER Thesis (20 credits)	Year 2: 4 courses from Group SPA8 1 course from Group SPA6-II 1 course from Group OTHER Thesis (20 credits)	Year 2: 2 courses from Group SPA8 4 courses from Group SPA6-II 0 courses from Group OTHER Thesis (20 credits)	Year 2: 5 courses from Group SPA8 0 courses from Group SPA6-II 0 courses from Group OTHER Thesis (20 credits)
Distribution of credits (second year): 30/30 (nominal)	Distribution of credits (second year): 32/28 (nominal)	Distribution of credits (second year): 28/32 (nominal)	Distribution of credits (second year): 40/20

Study plans – typologies (approval in advance)

Typology A

Year 2:

3 courses from Group SPA8 (24 credits)

2 courses from Group SPA6-II (12 credits)

2 courses from Group OTHER (4+ credits)

Thesis (20 credits)

Distribution of credits (second year): 30/30 (nominal)

"free" means B or C

EXEIN													
EXall	190				Types								
	A1	A2	A3	A4	A5	A6	A7	A8	A9	Educational activities	Year	Sem	CFU
PA8										5 mandatory core courses		1,2	48.0
	C	С	C	C	С	С	1	T	-	1 course from Group SPA6	1	2	6.0
PA6-II	С	С	С	-	-	-	_		-	1 course from Group SPA6		2	6.0
THER	3 B	2 B + 1 C	1 B + 2 C	3 B	2 B + 1 C	1 B + 2 C	3 B	2 B + 1 C	1 B + 2 C	3 courses from Group SPA8		1	24.0
	2 free	1 B + 1 free	2 B	1 C + 1 free	1 B + 1 free	2 B	2 C	1 B + 1 C	2 B	2 courses from Group SPA6-II	2	1,2	12.0
					-					2 courses from Group OTHER		2	4.0+
minal)					7-					Thesis and final exam		1,2	20.0

Study plans - typologies

Descriptions of the study plans typologies will be available in the next weeks at:

https://ccs-aerospaziale.polimi.it/piano-degli-studi/

Educational profiles

An educational profile is an educational pathway suggested to the students which is structured in an indication of courses considered functional for the training of a professional and cultural figure with a certain characterisation and/or specialisation.

Outcome:

- figure specialized in [ep] -

Payload and Operations

Spacecraft Design

Launchers

[...]



Educational profile – EXAMPLE

Name: Payload and Operations

Contact person: Mauro Massari

Study plan typology (types): A (A2/A5)

Description:

The profile aims to train engineers able to develop the activities related to the **design and operation of typical scientific instruments onboard spacecraft**. Starting from a common basic engineering background and essential spacecraft system engineering, the educational pathway focuses on the **physical and technological principles used in the design of satellite payloads, mainly for remote sensing and navigation applications.**

EXCIP					
	Туре	Courses	Year	Sem	CFU
	В	5 mandatory core courses		1	48.0
	С	ELECTROMAGNETIC AND SIGNAL PROCESSING FOR SPACEBORNE APPLICATIONS	1	2	6.0
	C/-	one of: SPACE PHYSICS HEAT TRANSFER AND THERMAL ANALYSIS OPERATIONS RESEARCH	-	2	6.0
	В	PAYLOAD DESIGN	2	1	8.0
	C	REMOTE SENSING FOR EARTH OBSERVATION AND SURVEILLANCE		1	8.0
	В	one of: MODELING AND SIMULATION OF AEROSPACE SYSTEMS ESTIMATION AND LEARNING IN AEROSPACE		1	8.0
	C	SATELLITE COMMUNICATION AND POSITIONING SYSTEMS		1	6.0
	В	free		2	6.0
		INTRODUCTION TO RESEARCH another course from the Group OTHER		2	4.0+
	_	THESIS AND FINAL EXAM		1,2	20.0

Educational profiles

Descriptions of the suggested educational profiles will be available in the next weeks at:

https://ccs-aerospaziale.polimi.it/piano-degli-studi/

What is

The Master's Thesis is an in-depth theoretical/numerical/experimental research or design assignment in a specific topic/field of expertise chosen by the student.

The topic of the Thesis should be (broadly) related to the aerospace field (preferably to the educational profile – if any).

Study goals

The students should be able to:

- demonstrate they are capable of independently apply relevant theory/knowledge to research and/or design
- interpret obtained results in a critical manner
- produce results with scientific/technological relevance
- critically reflect on the work performed at the level of their peers in their particular field
- present the work performed in a well-structured and well-written report
- present the work performed in a structured way through an oral presentation to their peers and wider audience
- plan the project efficiently considering resources and methodology

Start and duration

The nominal duration of the Master's Thesis is 500 hours (20 credits), approximately 4 months full time.

The thesis project can start at any time during the second year of the Study Programme.

[PLANNED] An application for managing the official start of the thesis is expected to be available soon (formal notification of the supervisor/subject, formal acceptance of rights and duties, NDAs (if any)).

Authors

The thesis project can be developed individually or with another Polimi MSc student (maximum 2 authors).

Organization

In order to start the Thesis you must have a thesis topic and a supervisor (see later "Supervisor").

Students are free to select a thesis topic from those proposed by faculty members within Polimi (contact them to get information on available topics).

Students are welcome to propose their own thesis topic or acquire a topic outside the university.

The project can be carried out in-house but also in collaboration with industries or external (research) organizations.

Supervisor ("Relatore")

The Thesis must have a supervisor, who is a professor at Polimi or an adjunct professor at Polimi in the current or previous academic year.

In the case of topics acquired outside Polimi (e.g., private company or external organization), find a suitable supervisor, discuss the project with him/her and get your proposal approved.

Faculty members may refuse students (lack of expertise, limited places, ...). In case of problems, contact the coordinator.

Co-supervisor(s) ("Corelatore/i")

The Thesis can have one or more co-supervisors – the project can be supervised with the collaboration of one or more PHD students, post-docs, external professors, external professionals, ...

Opponent ("Controrelatore")

When registering for the final exam, the student may request that the Thesis is evaluated by an Opponent (external reviewer with a strong expertise in the topic of the project).

The request must be approved by the Supervisor. Approval is based on the students' personal contribution and the academic level reached by the project in terms of original scientific research and/or technological innovation.

Final Exam

When you have finished the thesis project and you have cleared all the courses, you can request to take the final exam (four sessions per year – April, July, October, December).

The request must be made (about) one month before the graduation date and must be formally approved by your supervisor.

Once registered for the final exam, you have to submit the thesis report.

The thesis work is orally presented and discussed (about 20 minutes) during the final exam (graduation date).

Evaluation of the Thesis

After the presentation and discussion of the Thesis, the Committee shall assign a score to the Final Examination.

For the Final Examination of the Master Degree, the score assigned by the Committee shall have a minimum value of -1 (minus one) point and a maximum value differentiated as specified below:

- a maximum value of 4 (four) points for theses without Opponent;
- a maximum value of 7 (seven) points for theses with Opponent;
- a maximum value of 8 (eight) points for theses with Opponent if there is a "judgement of excellence" in the assessment of the supervisor and the Opponent and if all the members of the Committee agree.

Regulations

Polimi

available at: https://www.normativa.polimi.it

School of Industrial and Information Engineering

available soon at: https://www.ingindinf.polimi.it/it/esami-di-laurea

Degree Studies in Aerospace Engineering:

available in the next weeks at: https://ccs-aerospaziale.polimi.it/tesi-di-laurea-magistrale/

Additional activities

Additional courses

You can always add additional courses outside the basic course plan You may choose classes also from PhD Schools They cannot be exploited to reach the required 120 credits

Internship in a company

You are advised to add an internship (stage) to your course plan It cannot be exploited to reach the required 120 credits **www.careerservice.polimi.it** facilitates contacts with companies and seeks job opportunities

Participate to student competitions

- AHS Student Competition
- AIAA for Aeronautical students
- AIAA for Space students
- Airbus Fly your Ideas





Team Aeroswitch (Politecnico di Milano), 1st Place Graduate Team Aircraft Design, 2020

Additional activities

Passion in Action

"Passion in Action" is a catalogue of open participation teaching activities that the Politecnico offers to students to support the development of transversal, soft and social skills and to encourage/facilitate students in enriching their personal, cultural and professional experience.

This opportunity is open to everyone. Students may choose from a range of subjects depending on their own interests and personal aptitudes. Students taking part in "Passion in Action" can register for any of the activities in the catalogue, regardless of whether they are related to the programme in which they are enrolled (subject to any prerequisites for access to individual initiatives).

Acquired skills will be accredited on the Diploma Supplement.

PASSION IN ACTION

L'ESPLORAZIONE SPAZIALE: DALLA TECNOLOGIA ALL'ECONOMIA (Conferenze, cicli di seminari, convegni)

> MATEMATICA E MUSICA (ONLINE)

CORSO DI STORYTELLING (Didattica frontale)

Additional activities

STUDENTS' ASSOCIATIONS AT POLITECNICO DI MILANO

https://www.polimi.it/en/currentstudents/representatives-andassociations/



Skyward experimental rocketry

Active student association operating inside Politecnico di Milano, born in 2012 with the ambitious goal of designing and realizing small and medium sized experimental probe-rockets.



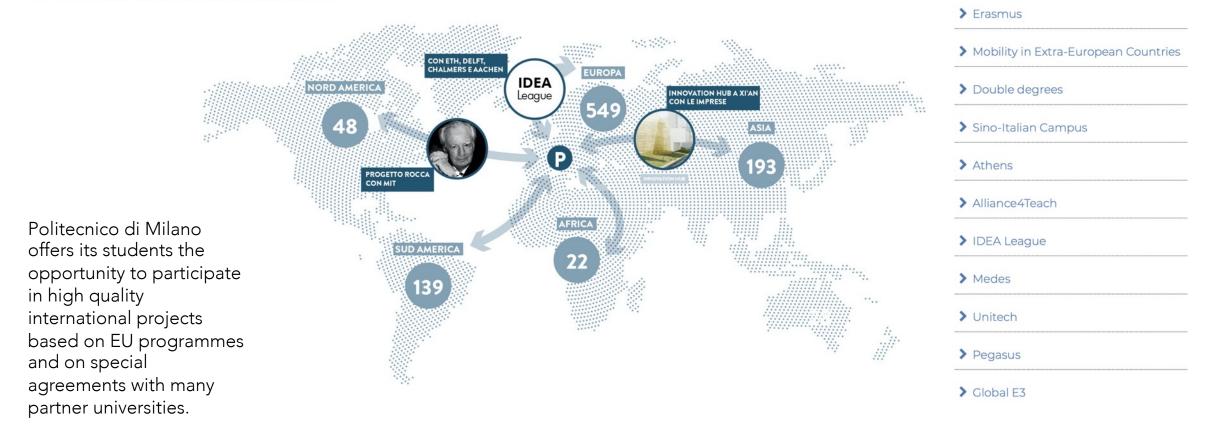
Polispace

Non-profit student organization founded in September 2020, with the aim of offering students hands-on experiences on real space engineering projects, helping them building their network in the aerospace sector, spreading the aerospace culture and opportunities.



International mobility

GAIN EXPERIENCE ABROAD



Department of Aerospace Science and Technology

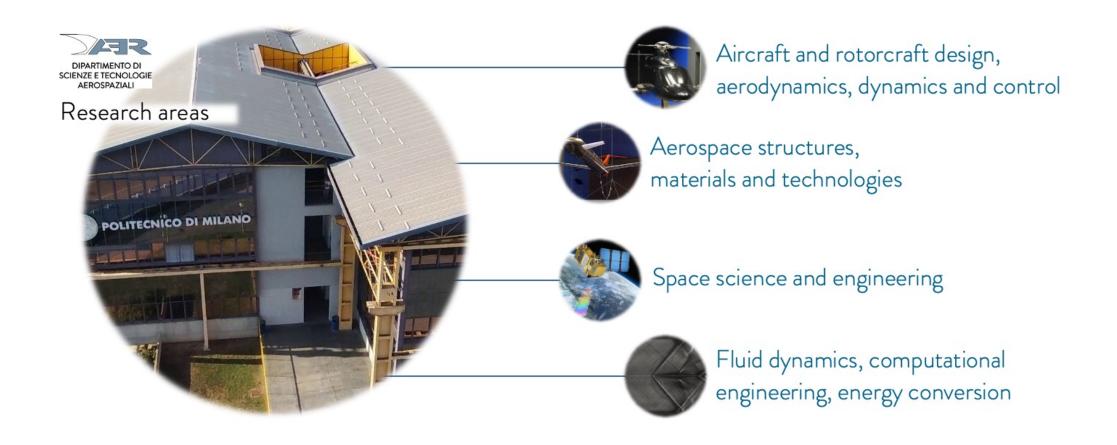
The educational offer of the Master Degrees in Aeronautical Engineering and Space Engineering is highly connected with the research activities carried out by the Department of Aerospace Science and Technology (DAER)



DAER numbers:

- 50 faculty members (professors and researchers)
- 30 technical and administrative staff
- 100 PhD students, post-docs, adjunct researchers

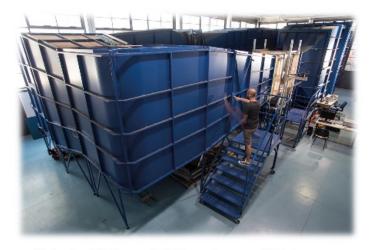
Department of Aerospace Science and Technology



Department of Aerospace Science and Technology

Research infrastructures





Galleria del Vento del Dipartimento di Scienze e Tecnologie Aerospaziali del Politecnico di Milano



Contact persons

President/coordinator of the Study Programme: prof. Lorenzo Dozio

Admissions: prof. Riccardo Vescovini

prof. Mauro Massari (international students)

Study plans (LM AER): prof. **Alessandro Croce**

Study plans (LM SPA): prof. Pierluigi Di Lizia

International mobility : prof. Paolo Astori

Final exam: prof. Antonella Abbà

prof. Federico Piscaglia

https://ccs-aerospaziale.polimi.it



PRESENTAZION

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STUDENTI ISCRIT

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CONTATTI



Questions?

