AEROSPACE ENGINEERING

A CENTRE OF EXCELLENCE FOR LEARNING AND SCIENTIFIC RESEARCH
Internationalisation is a distinguishing feature of all Aerospace courses at Sapienza. Within the framework of the ERASMUS and ERASMUS Placements mobility programmes, the teaching modules, and/or the final project of the Master of Science courses, can be undertaken at the most important schools of Aerospace Engineering in Europe. Sapienza is full member of the PEGASUS Consortium (a network of the best European Aerospace Universities), EUGENE (Academic Network European and Global Engineering Education) and ISU (International Space University). These international networks offer shared education programs and provide accreditation to its members. Our courses also favour internships of current and former Sapienza students at the most important aerospace industries. Sapienza underwrote educational and research agreements with Carleton University (Canada), Purdue University (USA), Clarkson University (USA), University of Notre Dame (USA), KAUST(Saudi Arabia), Moscow Aviation Institute (Russia), and double degree programs with ISAE - SUPAERO (France), Instituto Superior Técnico de Lisboa (Portugal) and Universidad Politécnica de Valencia (Spain).

Tradition
The long tradition of Sapienza University in the field of Aerospace Education dates back to 1926, with the establishment of the School of Aeronautical Engineering, which provided postgraduate training to a selected group of engineers. The fast growth of the aerospace industry and of the research activity in the sector prompted the need for a more complete and balanced teaching offer. On 1963, the postgraduate education was entrusted to the School of Aerospace Engineering. On 1980, the Faculty of Engineering established a five-year course in Aeronautical Engineering aimed at a wider range of students. On 1990, a five-year course was established in Aerospace Engineering, which also included a curriculum in Space Engineering. In recent years, the Aerospace Education at Sapienza has been reorganised in one three-year Bachelor Degree in Aerospace Engineering and three Master of Science Degrees (Aeronautical Engineering, Space Engineering, and Astronautical Engineering). On 2012, the two courses in Space Engineering and Astronautical Engineering merged into the Master of Science Degree in Space and Astronautical Engineering. After the Master of Science Degree, the training in Aerospace can be continued at Sapienza by joining one of the three one-year Professional Master Courses in Civil Aviation, in Satellites and Orbiting Platforms, or in Space Transportation Systems. Finally, the educational offer is completed with a three-year Ph.D. Course in Aeronautical and Space Engineering.

Interdisciplinarity
The teaching offer at Sapienza entails an interdisciplinary approach that reflects the technological developments among the multiple academic disciplines in aerospace, as well as the particular characteristics of the industry for which multidisciplinary skills are increasingly perceived as an added value.

Objectives
To offer high quality teaching in aerospace engineering with the goal of developing the student knowledge and skills in formulating, analysing, and solving new and challenging problems. To offer study pathways that attract talented young people who are strongly motivated, interested in aerospace engineering, and eager to take positions of responsibility in industry, academia, or state entities and institutions. To promote internationalisation of the study pathways by favouring the mobility of students within the European university systems, in the most effective way. To favour a collaborative and interdisciplinary approach on aerospace disciplines that stimulates the creativity of students with a firm background in the basic academic disciplines. To offer a complete overview of the prospects and opportunities in the job market, and promote the creation of study pathways geared up with the expectations of the industrial world where academic knowledge is complemented by the specific skills that industry seeks.
Aerospace at Sapienza University

Aerospace education at Sapienza University is structured in a three-year Bachelor Degree in Aerospace Engineering, in a two-year Master of Science Degrees in Aeronautical Engineering and in a two-year Master of Science Degree in Space and Astronautical Engineering.

Aerospace is a highly innovative industrial environment that requires and absorbs young, motivated, and talented engineers, who should know how to operate in a globalized and highly competitive job market. The educational programs in aerospace need to timely update their offer of knowledge and skills, so that our graduate students will be smoothly integrated in a constantly evolving aerospace industry. In this context, we envision Aerospace Engineering at Sapienza as a community of students and tutors who operate as an educational system that, also thanks to a close collaboration with external tutors from industry, research centres, and institutions, pursue the following goals:

- To achieve and maintain levels of excellence in education and science
- To promote and reward the value of knowledge and the passion for study and research
- To stay at the cutting-edge of technologies in continuous development
- To look at aerospace as a key sector for cultural inspiration and economic value, offering students and researchers unique opportunities to contribute to the technological development in key areas such as air and space transportation, communications, space exploration, and safety
- To promote internationalisation and multiculturalism in a globalized technology and job market
- To favour environmental and social spinoff from research and development.

Our three-point mission

- To unfold the full potential of highly qualified engineers in the design, analysis, implementation, and operation of aerospace systems and processes, and make them fit for taking leading positions in this competitive and highly internationalised environment.
- To contribute to the advancement of knowledge and its applications in the aerospace disciplines.
- To contribute to the growth and development of Italy by making use of the abilities and quality of our graduates and tutors.

Professional Master courses:
- Civil aviation management
- Satellites and orbiting platforms
- Space transportation systems: Launchers and re-entry vehicles

PhD in Aeronautical and space engineering

1,350 students on the courses
- 60 specific courses in the aerospace sector
- 40 professors engaged in teaching and research on aerospace topics
Bachelor Degree in Aerospace Engineering

The objective of the three-year Bachelor Degree in Aerospace Engineering is to provide our graduates with a solid grounding in mathematics and physics, and the fundamentals of aeronautical engineering, space engineering, and aeronautics.

We offer experimental and numerical workshop modules to acquaint the student with the methodologies and applied knowledge that make him/her ready for a rapid and successful integration in the job market. The skills acquired by our graduates on completion of this course enable them to operate effectively in the working environment.

This course provides a foundation for graduate-level engineering study for all students willing to enter the Master of Science Degrees in Aeronautical Engineering and Space and Astronautical Engineering

Objectives

- To provide students with the fundamental aerospace engineering training they need to start exciting careers in the aerospace engineering field.
- To provide extensive training in the traditional aerospace sectors as well as the emerging sectors of Information engineering

Career prospects

The skills that our aerospace engineers acquire create career opportunities in firms, agencies, and institutions that are involved in various ways with aircraft manufacturing or space mission management, e.g.:

- Aircraft maintenance personnel
- Airport facilities personnel
- Commercial design software operators in aerospace companies
- Consultants to service companies and public authorities

Admission requirements

Admission to the Bachelor Degree requires a secondary school diploma or its recognized equivalent if the applicant is a foreign national.

Other requirements are: ability to think logically, an adequate background in mathematics and good knowledge of the Italian language.

The enrollment of students in the Course of Aerospace Engineering (class L-9) is subject to participation in a procedure for admission, where the total planned number of available places is attributed into three successive calls, called “selections,” for each of which a certain number of openings is available.

Requirements are verified during the admission process which is based on the TOLC-I test result. Such test can be taken at La Sapienza or at any of the other university sites of the CISIA consortium. Student rankings will be based on test results.

YEAR 1

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Calculus I</td>
<td>9 CFU</td>
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<tr>
<td>Calculus II</td>
<td>9</td>
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<tr>
<td>Chemical principles</td>
<td>9</td>
</tr>
<tr>
<td>Geometry</td>
<td>9</td>
</tr>
<tr>
<td>Physics I</td>
<td>9</td>
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<tr>
<td>Calculus lab.</td>
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YEAR 2

<table>
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<th>Course</th>
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<tr>
<td>Analytical mechanics</td>
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</tr>
<tr>
<td>Applied physics</td>
<td>6</td>
</tr>
<tr>
<td>Materials science and technology</td>
<td>6</td>
</tr>
<tr>
<td>Physics II</td>
<td>9</td>
</tr>
<tr>
<td>Aerodynamics</td>
<td>9</td>
</tr>
<tr>
<td>Applied mechanics and technical drawing</td>
<td>9</td>
</tr>
<tr>
<td>Electrotechnics</td>
<td>6</td>
</tr>
<tr>
<td>Mechanics of solids and structures</td>
<td>6</td>
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</tbody>
</table>

YEAR 3

Typical subjects required for the various sectors of aerospace engineering

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Aerospace structural analysis</td>
<td>9 CFU</td>
</tr>
<tr>
<td>Aerospace propulsion</td>
<td>9</td>
</tr>
<tr>
<td>Flight mechanics</td>
<td>9</td>
</tr>
<tr>
<td>Programming and numerical methods</td>
<td>9</td>
</tr>
<tr>
<td>Aerospace telecommunication systems</td>
<td>9</td>
</tr>
<tr>
<td>6 credits chosen from:</td>
<td></td>
</tr>
<tr>
<td>-Aeronautical propulsion systems</td>
<td>6</td>
</tr>
<tr>
<td>-Aircraft systems</td>
<td>6</td>
</tr>
<tr>
<td>-Multidisciplinary aircraft analysis and design</td>
<td>6</td>
</tr>
<tr>
<td>-Space environment</td>
<td>6</td>
</tr>
<tr>
<td>-Space exploration systems</td>
<td>6</td>
</tr>
<tr>
<td>-Space systems</td>
<td>6</td>
</tr>
<tr>
<td>-Technologies for metallic and composite aerospace structures</td>
<td>6</td>
</tr>
<tr>
<td>Choice of one workshop module</td>
<td>3</td>
</tr>
<tr>
<td>Choice of two additional subjects</td>
<td>12</td>
</tr>
<tr>
<td>Thesis project or practical training</td>
<td>5</td>
</tr>
</tbody>
</table>
Course structure

- Year 1 consists of 6 modules (54 ECTS). These modules consolidate the student's knowledge of the characterizing sectors of aeronautical engineering, and teach the fundamentals of specific sectors that are not covered in the three-year Bachelor Degree, such as telecommunications and automatic controls.
- Year 2 includes two curricula: one is discipline oriented (Modeling and analysis for aircraft design), the other is thematic oriented (Flight Systems, management and operations). The student can choose 5 modules among those in offer for a total of 30 ECTS.
- This learning pathway is completed by 12 ECTS chosen by the student, plus either the thesis project or an internship (23 ECTS).
- This course is part of an Italian-French network that provides for the reciprocal recognition with Toulouse ISAE-SUPAERO. A second double degree can be obtained at the Instituto Superior Tecnico Universidad de Lisboa.

Career prospects

The skills acquired on this Master course open up career prospects in a very wide range of technical and managerial roles, such as:

- research and development technician and/or coordinator in public and private research centres
- designer or projects manager in aeronautics firms
- roles in service companies (such as airlines) that relate to aircrafts, e.g. maintenance manager, fleet planner, airport manager
- roles in agencies that provide services to the air traffic system.

Admission requirements

The applicant is required to hold a three-year Bachelor Degree, possibly in Aerospace Engineering. Each candidate’s curriculum and personal background are verified. Applicants should meet specific curricular requirements before they can enroll.

Modeling and analysis for aircraft design

This curriculum trains engineers who are specialized in the numeric, theoretical, and experimental analysis of aeronautical materials and structures and who are provided with the technical skills associated with fixed and rotating-wing aircraft. Moreover, it provide the students with the criteria and techniques of engine design, and with the tools to predict and verify the engine performance. The skills acquired enable the student to use theoretical, numerical, and experimental methodologies to carry out the aerodynamic analysis and solve for a complete aircraft and/or of its components.

Flight systems, management and operations

This curriculum covers a range of disciplines (aerodynamics, flight mechanics, automatics, robotics, electronics, and communications) that provide methodological tools for facing problems related to air transport systems. It trains system engineers in the ability to deploy integrated knowledge in telecommunications, guidance and navigation, on-board systems, flight simulation, and technical airport services, and to deal with all technological aspects of aircraft management and air traffic control.
Master of Science Degree in Space and Astronautical Engineering

In the Master of Science Degree in Space and Astronautical Engineering the student acquires specific skills in space mission planning and the analysis and design of launch vehicles, satellites, and remote metering and telemetry systems, with particular reference to systems-related and interdisciplinary aspects. The learning pathway makes use of advanced methods and tools for studying space and astronauts systems. This Master course has a strong on going relationship with research and innovation in the Italian and European space industries.

Course structure
- Year 1 consists of 7 modules for a total of 60 ECTS. These modules consolidate the student’s knowledge in the characterizing sectors of space engineering (gas dynamics, structures, flight mechanics, propulsion, and space systems). It also includes the fundamentals of specific sectors that are not covered in the three-year degree Bachelor in Science course, such as electronics and automatics.
- Year 2 includes 5 thematic pathways (Launch Vehicles, Satellites, Earth Observation, Missions and Aerospace Engineering) organised into groups from which the student chooses 4 modules for a total of 24 ECTS.
- This course is completed with 12 ECTS chosen by the student, plus either the thesis project or an internship (23 ECTS).
This course forms part of an Italian-French network that provides for reciprocal recognition with other selected universities and Grandes Ecoles in Paris, Grenoble, Toulouse, Nantes, and Nice.

Career prospects
- In industry as a designer or projects manager
- In national and international space agencies planning implementing, and managing space missions
- In public and private research centres
The Space and Astronautical Engineering graduate is also qualified to work in affine sectors that can profit of the high level of scientific and technological skills acquired at completion of this course.

Admission requirements
The applicant is required to hold a three-year Bachelor Degree, possibly in Aerospace Engineering or Information Engineering. Each candidate’s curriculum and personal background are verified. Applicants should meet specific curricular requirements before they can enroll.

Launch vehicles
Topics covered in this learning pathway include the design of solid and liquid-fuelled propulsion systems, re-entry vehicles, guidance, navigation and control of launchers, and structural problems of launchers. Thanks to the involvement of Sapienza University in the VEGA programme, students acquire knowledge at the systems level, from the conception and design of a launcher up to completion of the launch campaign.

Aerospace Engineering
This learning pathway is entirely given in English. It offers to foreign students advanced disciplinary and professional training and specific engineering skills, enabling them to address aerospace-related problems requiring analysis, development, simulation, and optimization. The first year provides a foundation of knowledge in the major areas of Space and Astronautical Engineering; in the second year the student may focus on a wide range of topics selecting a set of follow-on courses in Space, Astronautical and Aeronautical Engineering.

Remote sensing from Space
Topics: the use of satellites for telecommunication applications; acquisition and processing of ground images using optical and radar systems. Students analyse and experience the whole cycle of development of these missions, from selection and design of the observation payload to information extraction techniques for processing and using the images obtained.

Satellites
This learning pathway focuses on the general design of a satellite system with particular reference to the general architecture of the platform, the energy and thermal budget, structural and technological problems, telecommunications, electrical, and electronics subsystems, orbital and attitude control. Students can benefit from a wide range of workshops and the experience of tutors in the design, construction, launch, and in-orbit operation of small platforms.

Missions
Objective: to train engineers specialised in the analysis of earth orbit missions and solar system exploration missions. Topics: orbit design and orbital control, with particular reference to the most advanced techniques for trajectory analysis and optimisation. There is a focus on the technological areas of major relevance and interest, such as robotic missions, and missions carried out by constellations and formations of satellites.

Since 2016-2017 a learning pathway entirely given in English has been activated.
The following courses available in all curricula are taught in English:
Aerospace materials, Artificial intelligence 1, Control Systems, Control of flying robots and robotic systems, Digital control systems, Human factors, Liquid rocket engines, Multibody space structures, Solid rocket motors, Space guidance and navigation systems, Space missions and systems, Spacecraft control.
Student life

Studying Aerospace at Sapienza means being part of a highly stimulating environment with an intense student life. 

Rome offers unlimited cultural and social opportunities. The Aerospace Engineering courses take place at the Faculty of Civil and Industrial Engineering right in the centre of the city, at walking distance from the Colosseum, the Roman Forum, and the Capitoline Hill. Our students can become members of Sapienza Student Aerospace Association (SASA), the student branch of the American Institute for Aeronautics and Astronautics (AIAA): SASA organises seminars, technical visits, and social events that promote the interests, ideas, and involvement of students in aerospace topics. 

To foster the personal growth of students, the Aerospace Engineering School favors and supports the participation of student teams in prestigious international competitions and projects such as:

- AIAA Cessna Design/Build/Fly (DBF) competition, which takes place in the US and involves the design of a small UAV prototype;
- European Student Moon Orbiter (ESMO) promoted by the European Space Agency, for the design of a satellite in lunar orbit;
- Global Trajectory Optimization Competition (GTOC), which each year challenge the participation from research centres, space agencies and universities from all over the world in resolving a complex space flight problem.

The Aerospace Engineering School monitors the placement and the careers of his former students in association with Alma Laurea and the Sapienza Aerospace Alumni Association (SARA) to create a network of professionals which shares a common educational root, and to facilitate the hiring of his graduates within a network that is appreciated by aerospace companies at the national and international level. 

The main goals SARA consists in:

- Promoting the exchange of information among the alumni of the aerospace courses 
- Coordinating and promoting events that can prompt professional and cultural growth 
- Promoting actions that encourage the development of Aerospace Engineering at Sapienza 
- Promoting the interaction among alumni, research centres, industry, and government agencies in the aerospace sector

Scientific and technological skills

Our students work with tutors who are intensively involved in research and technological development. This involvement is especially intense while the students carry out their Master thesis as well as during the whole PhD program, when the students have the opportunity to take part and actively contribute to international research programmes that achieved highly significant outcomes. The most successful examples are (the participation to (i) the structural and propulsion design of the European launcher VEGA; (ii) the Mars Express program, which proved the presence of water on Mars; and (iii) the Cassini-Huygens missions, which discovered an ocean below the surface of Titan.

Our contribution to research and development


Aerospace Engineering at Sapienza University is ranked first in Italy, third in Europe and 17th in the world according to the Shanghai Ranking's Global Ranking of Academic Subjects 2018.
The main career opportunities for graduates in Aerospace Engineering are in aeronautical and space industries, air transport service companies, national and international research agencies, space agencies, and universities. Nonetheless, a graduate student in Aerospace Engineering possesses a background in the fundamentals of engineering so broad and solid that allows him/her to quickly become successfully acquainted with methods and technologies in very many industrial engineering sectors other than aerospace.

The workplace may be regional, national, or, more and more often, European.

**Career prospects**
- Aerosekur
- Airbus
- ATR
- Avio
- Carlo Gavazzi
- ELV – Space Lab
- General Electric
- Leonardo - Aeronautics
- Leonardo - Airborne and Space Systems
- Leonardo - Aircraft
- Leonardo - Helicopters
- MBDA
- Sistemi
- Rolls Royce
- Telespazio
- Thales Alenia Space
- Vitrociset
- Vulcain

**Management Companies**
- Aeroporti di Roma
- Sa

**Regulatory bodies**
- ENAC
- ENAV

**Research centers**
- CIRA
- CSM
- INSEAN
- VON KARMAN INSTITUTE

**Space Agencies**
- ASI
- ESA