

*Excellence with passion*



**MASTER OF SCIENCE,  
ADVANCED MASTERS &  
EXECUTIVE EDUCATION PROGRAMS  
IN AEROSPACE ENGINEERING  
& MANAGEMENT**

2021



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Olivier Lesbre



Didier Delorme

## WELCOME TO ISAE-SUPAERO

**The challenge in the medium term for the aviation sector is the ecological transition: it is an exciting challenge for our engineers and the coronavirus crisis is speeding up this transition**

In one century, aeronautical engineers have taken up extraordinary challenges. After inventing aviation, they made air transport very safe, then accessible to all. We're no longer surprised, but fifty years ago who would have predicted that it would not only be faster and more comfortable, but also safer and less expensive to take a plane rather than a car or train when traveling distances greater than 1,000 km?

Air transport has made equally impressive progress in energy efficiency. The latest aircraft such as the A350 can fly at 800 km/h while consuming less than 2.5 l per 100 km per passenger. Aviation's contribution to global CO2 emissions has thus remained marginal (approximately 2.5%, or one-fortieth of all emissions).

But that is not enough if we want aviation to continue its development. After inventing safe, democratic air transport, the aviation sector now has to decarbonize it. This is a new challenge, one requiring as much ambition as previous challenges. New aircraft will have to be invented, working with all aspects of technology and our engineers' creativity.

Technological opportunities have been identified: ever lighter materials and structures, refined aerodynamics, new aeropropulsive integration, electrification of systems and actuators, with a particular challenge in the area of engines and the replacement of fossil jet fuel with other energy carriers. A considerable amount of work remains to be done to bring all these technologies to maturity and to ensure the level of reliability and safety required for use in air transport. This is the job for a new generation of engineers!

The coronavirus crisis is turning into an opportunity for the aviation sector, and especially for young engineers. Work needs to begin immediately - this is an extraordinary challenge for our design offices, a challenge for the next 20 years! This has already been well understood by the engineering students all over the world and the number of applicants for our masters programs has never been higher than in 2020.

**ISAE-SUPAERO is playing its role in foreseeing these changes and providing its students with the keys to invent the world of tomorrow**

It is in this spirit that ISAE-SUPAERO is adopting a renewed strategy in the area of sustainable development. The specific skills found at the Institute in terms of training, research and innovation mean that it can grasp the problem of air transport's impact on global warming and significantly contribute to finding solutions.

Since 1909, ISAE-SUPAERO has been training high-level engineers and managers who have brought about advances in the aerospace industry. Our current students are those who will meet the challenges of decarbonized aviation, which is why our programs are evolving to prepare them for the task. We have always educated creative, rigorous, committed engineers who are capable of mastering complex systems.

By also providing training in the challenges of sustainable development and the energy transition, we are preparing our graduates to build a sustainable society and to invent the decarbonized air transport of tomorrow.

For years our research has been directed at future generations of aircraft and mobility for tomorrow. We are working on questions of propulsion, aerodynamics, materials and eco-design for all systems, but also on intelligent man-machine collaboration. Our students are in immediate contact with our laboratories and many of them contribute directly to R&D projects.

The ecological transition in air transport is an exciting challenge for a new generation of engineers. ISAE-SUPAERO is mobilized to give them the keys to take up this challenge successfully.

**Olivier Lesbre**  
President of ISAE-SUPAERO

**Didier Delorme**  
Dean of Masters programs

# A WORLD LEADER IN AEROSPACE ENGINEERING HIGHER EDUCATION

We have already trained more than 23 300 engineers who are contributing to the development of the aeronautics and space sector in France and around the world.

Our engineers' vocation is to become future leaders in the aerospace industry and the world of tomorrow.

That is why we have developed an integrated approach with training, research and innovation in partnerships with academic players, many industrial stakeholders and a network of the best international universities.

## ISAE - SUPAERO

IS A PUBLIC INSTITUTION OF HIGHER EDUCATION AND RESEARCH

A WIDE  
RANGE OF  
DEGREE  
PROGRAMS IN  
AEROSPACE  
ENGINEERING

3 **MASTERS PROGRAMS**

15 **ADVANCED MASTERS PROGRAMS**

6 **DOCTORAL PROGRAMS (PHD)**

16 **CERTIFICATES**

1700 **STUDENTS** : 1500 **MASTERS AND** 200 **PhDs**

33% **OF FOREIGN STUDENTS**

56 **NATIONALITIES ARE PRESENT ON CAMPUS**

**AN ACTIVE INTERNATIONAL ALUMNI NETWORK**

## AN OUTSTANDING CAMPUS

- Teaching spaces, cutting-edge research equipment (see p. 10)
- A complete range of athletic facilities:  
pool, gym, rock-climbing wall, fitness center, football and rugby fields, tennis and squash courts
- Student residences and the Student Center



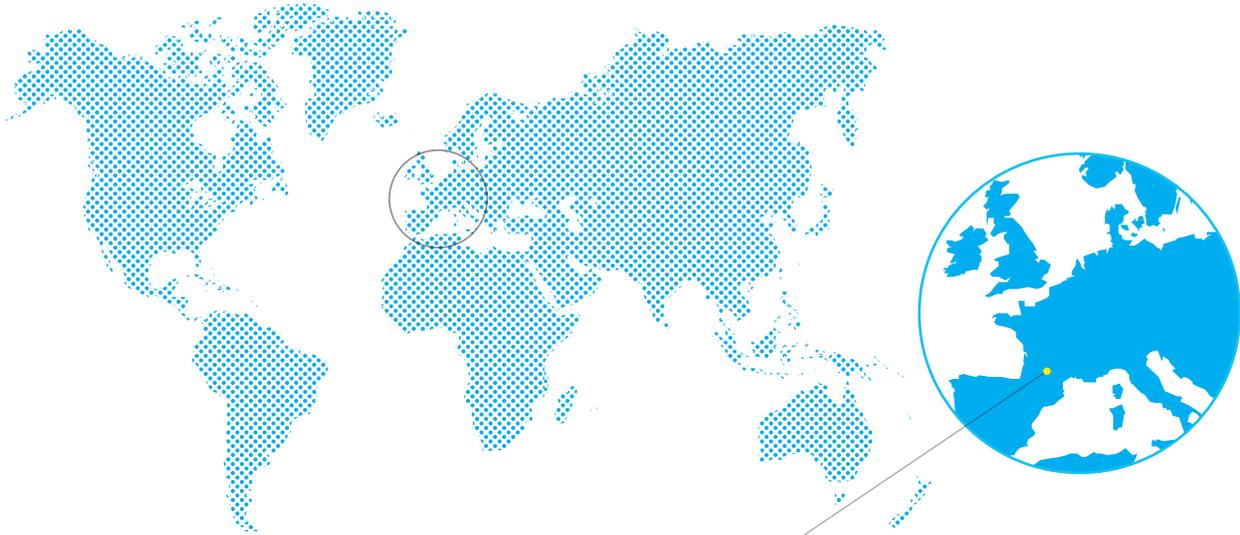
## The «Bienvenue en France» accreditation

The "Bienvenue en France" label accredited by Campus France, distinguishes French higher education institutions, which have developed reception measures made available to international students by French higher education institutions, and represents a promotional and outreach tool for the institution.

ISAE-SUPAERO is one of the few institutions undertaking the '3 star' certification. The certification demonstrates the quality of the reception of our school.

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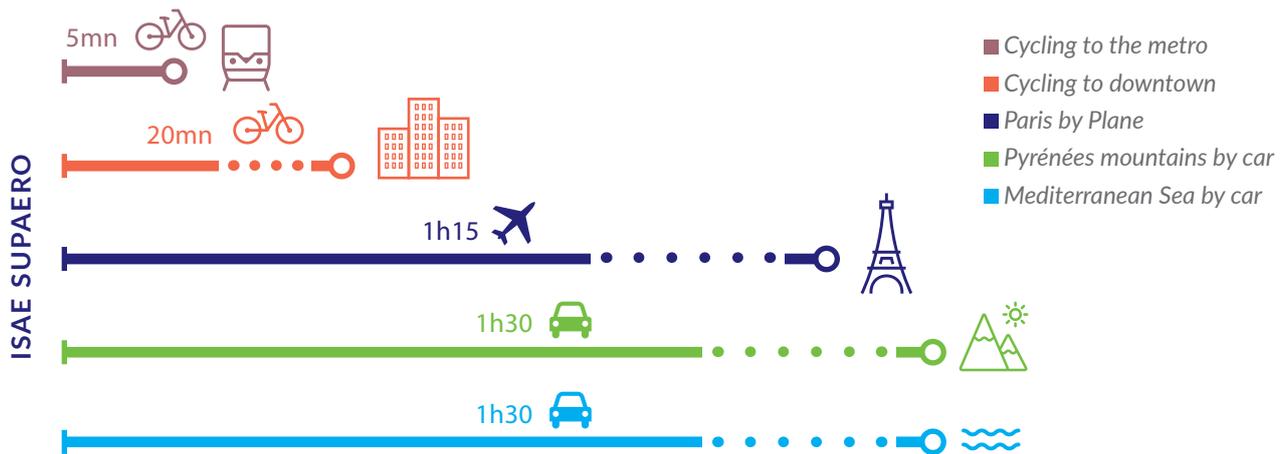
## A VIBRANT CITY A LIVELY CAMPUS



### TOULOUSE (FRANCE)

European Capital of aeronautics and space  
1st attractive city to study in France.  
An exceptional environment in the heart of  
Toulouse, Europe's leading hub of aerospace  
industries, laboratories and universities.

- Nearly 90,000 direct jobs in aeronautics and space
- The leading region in France for aeronautics education and research



# Master of Science, Advanced Masters, Post-Graduate Diplomas, Certificates of Advanced Studies and Short Courses



*We have developed a wide range of master's programs in aeronautics, space, embedded systems and management to provide the global aerospace industry with highly qualified engineers and managers capable of developing and delivering innovative solutions to the constantly evolving challenges facing industry and our society today.*

*To satisfy international demand for junior and senior engineers and managers, we offer two types of degrees: Master of Science and Advanced Master. We also deliver a range of professional certificates to managers looking to expand their skills in specific areas.*

## ■ Master of Science

120 ECTS

*The Master of Science is a two-year program undertaken after undergraduate studies, including Bachelor's degree or an equivalent degree. It provides higher qualification for employment or further doctoral studies.*

*The Master is accredited by the Ministry of Higher Education and Research in line with the Bologna process established in 1999 to harmonize the European higher education systems.*

*The two-year ISAE-SUPAERO Master of Science degree program is internationally renowned and highly regarded as an innovative program in science and technologies. Fully taught in English, this program is designed to prepare engineering students to find and develop solutions to today's and tomorrow's challenges facing the world and the aerospace industry.*

## ■ Advanced Masters Programs

75 ECTS

*The MASTERE SPECIALISE® is a collective trademark and label owned by the Conférence des Grandes Ecoles (CGE), a network of some of the finest French engineering schools. This label is attributed to specific training programs delivered by schools within the CGE. The highly rigorous accreditation process ensures the excellence of programs content.*

*The Advanced Master's program is a one-year course of professionally-oriented advanced studies, undertaken after completion of a Master's degree. Advanced Master's degrees delivered by ISAE-SUPAERO provide participants with unique, state-of-the-art knowledge and know-how in a specific domain for which aeronautics or space companies have a genuine need. Courses are delivered by specialists or experts from industry or state Organizations in collaboration with ISAE-SUPAERO faculty.*



## A multicultural student population

### ■ Post-Graduate Diplomas, Certificates of Advanced Studies and Short Courses

A number of post-graduate diplomas and certificates which are parts of our advanced masters are offered and have a great meaning for professionals who want to grow their skills.

Upon Completion, participants are awarded a diploma from the Institute.

- 9 Post-Graduate Diplomas **PGDip**

1 semester courses - 45 ECTS

- 16 Certificates of Advanced Studies **CAS**

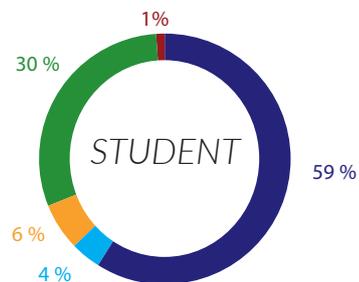
from 44 to 102 hours provide ECTS

- 55 Short Courses

from 12 to 51 hours

### ■ Origin of Master's students 2020

**398** total number of students



■ Europe ■ Africa ■ America ■ Asia ■ Oceania



# BUSINESS RELATIONS

250

companies support our development



1800

engineers, and/or researchers from leading companies are visiting lecturers. They deliver courses based on the latest industry developments and practices.



The ISAE-SUPAERO Career Center provides support for students entering the workforce

Every year companies receive more than

800

ISAE-SUPAERO students for internships and master thesis. Conferences, industrial visits, internships in companies, forums, recruitment workshops



An alumni network of over

23 300

graduates

More than 30 partnerships signed with small and medium-sized companies and major industrial players



12



company chairs for teaching and research in innovative programs in safety with Axa, transport aircraft innovative concepts and space with Airbus Group and Ariane Group, in technological innovation with Daher, Embedded systems engineering and architecture with Thales...

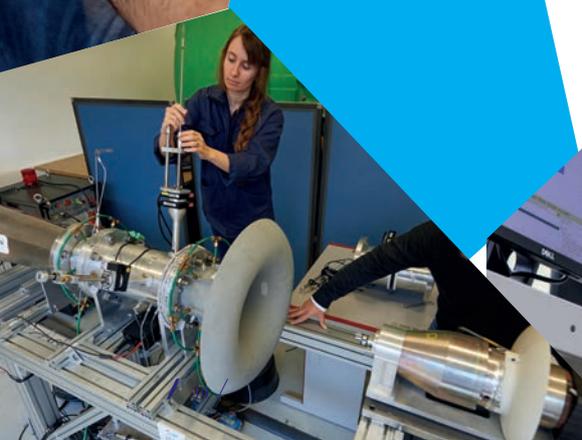
FUNDING  
Students can benefit from financial support from ISAE-SUPAERO Foundation and partners





## CUTTING-EDGE RESEARCH EQUIPMENT

- *Autonomous system platform for micro-drones and robots*
- *Critical embedded systems platform*
- *Flight simulators and neuroergonomics platform*
- *Wind tunnels, aeroacoustics wind tunnel*
- *Turbofan Test Bed*
- *Drop tower, gas guns*
- *Fleet of 9 aircraft : TB 20, Robin DR 400, Vulcanair P68 Observer...*
- *Software defined radio room*
- *Clean rooms for satellite integration*
- *Ground station for satellite tracking and operation*
- *Satellite command and control center*
- *Drones of all shapes and uses*





# RESEARCH-DRIVEN LEARNING

The pedagogical approach of the ISAE-SUPAERO Master's program is research-driven and designed to encourage students to engage in a wide variety of research opportunities throughout the program and beyond.

A multidisciplinary scientific policy:

## 5 training and research departments

1

### ■ **The Aerodynamics, energetics and propulsion Department - DAEP**

*develops its research activities on three axes:*

- Turbomachines and propulsion
- Aerodynamics
- Fundamental fluid dynamics

2

### ■ **The Mechanics, structures and materials Department - DMSM**

*is part of the Clément Ader Institute that gathers in a single laboratory all the research capabilities of the Occitanie Region (UPS, INSA, ISAE-SUPAERO, IMT Mines Albi-Carmaux).*

*ISAE-SUPAERO professors' research is focused on:*

- Mechanical system modelling
- Materials & composite structures
- Surface treatment

3

### ■ **The Electronics, optronics and signal processing Department - DEOS**

*is organized into 4 research groups:*

- Signal, communication, antennas, navigation
- Microelectronic image sensors
- Space systems for Planetology & Applications
- Optoelectronics for payloads and aerospace communications

4

### ■ **The Complex systems engineering Department - DISC**

*concentrates research driven in the multidisciplinary scientific fields:*

- Applied math
- Communication networks
- Decision making systems
- Engineering for critical systems

5

### ■ **The Aerospace vehicles design and control Department - DECAS**

*dedicates to the efficient and safe design and operation of vehicles.*

*The three research groups:*

- Aerospace Vehicles Design,
- Decision and Control,
- Neuroergonomics and Human Factors



# THE MASTER OF SCIENCE IN AEROSPACE ENGINEERING



## ■ Objectives

In order to support its steadily growing and to maintain business competitiveness, the global aerospace industry needs high qualified engineers or researchers. Design complex aerospace systems involve multinational geographically disseminated teams of project managers or various experts working in collaborative environment through integrated development platform tools. The Master of Science in Aerospace Engineering is intended to educate graduate students in subjects relevant to these demanding challenges and needs of the industry.

Giving students competences in engineering science, technology and design related to aeronautics and space, the MSc AE is designed to be multidisciplinary preparing future engineers to easily and efficiently work on aeronautical systems, space systems and their applications, with emphasis on the complete life cycle of the system. With a large spectrum of knowledge the MSc AE allows students to tackle various aspects from design to operations of products and systems either in a research organism or in an aerospace company in a multinational environment.

The MSc AE includes a total of 4 semesters of 30 ECTS each.

The first semester of the MSc AE focuses on the common core curriculum, while the second semester offers a wide choice of electives.

In the third semester, students choose from among seven concentrations spanning the main areas of aeronautical and space systems design including: «Advanced aerodynamics and propulsion», «Aerospace Structures», «Aerospace systems and control», «Embedded systems», «Space systems», «Systems engineering», «Space Imaging Navigation and Communication». Students have extensive opportunities to develop a scientific skills approach through research projects in ISAE-SUPAERO laboratories in second and third semesters along with on-the job skills during internships in the aerospace industry.

Students complete a master's thesis in the fourth semester.

## ■ Learning approach

The ISAE-SUPAERO Master's program is designed with a combination of lectures, tutorials, study cases and projects to be performed in industrial environment or in ISAE-SUPAERO's laboratories. It is taught in English.

The MSc AE program includes three-semester academic session, in ISAE-SUPAERO's premises, provided by permanent professors and experts from aerospace industry bringing current knowledge and experience.

The last semester consists in a master thesis to be performed in a company or a laboratory in the aerospace sector. After the thesis, students having obtained 120 credits under examination will be awarded the Master of Science in Aerospace Engineering from ISAE-SUPAERO

## ■ Syllabus

### SEMESTER 1: 30 CREDITS

#### Common core - 405 h

#### Sciences & engineering

Aircraft systems, Space systems, Airworthiness, Control, Aerodynamics & propulsion, Flight dynamics, Aeronautical structures, Applied mathematics, Computer sciences

#### Foreign languages

French as a Foreign Language.

French speakers can choose among: German, Arab, Chinese, Spanish, Italian, Japanese, Portuguese, Russian Intercultural workshop

#### Systems engineering

### SEMESTER 2: 30 CREDITS

#### Common core - 103 h

Mathematics – Mechanics – Optimization

Foreign languages - Soft skills

#### Electives - 120 h

- Aeroengines Architecture & Performance - Acoustics - Experimental Approach in fluid dynamics - Software for CFD
- Mechanics of materials & structures - Aircraft structures - Computational solid mechanics - Structure design project
- Object-Oriented Software Development - Simulation for systems engineering - Deterministic Signal processing and Digital Electronics Basics – Space Instrumentation
- Control of dynamic systems & implementation - Cloud and computer networking - Adaptive control - Real time control of an aerospace system
- MDO - Instrumentation & flight data analysis - Aircraft design methods

4 electives (among 19) are chosen by the students with the approval of their faculty advisor, taking into account their choice of 53 major and research project. These courses realize a definable intellectual goal.

#### Research Project - 250 h



## SEMESTER 3: 30 CREDITS

### Common part - 98 h

Project management - Foreign languages - Requirements Engineering

Students have to select one major among:

### Major 1: Advanced Aerodynamics and Propulsion - 208 h

Applied Aerodynamics - Aeroelasticity & Flexible Aircraft  
Aeroelasticity part - Aeroelasticity & Flexible Aircraft - Flexible Aircraft part - Advanced Aerodynamics of Turbomachinery  
Numerical Fluid Mechanics - Aeroacoustics - Physics and Modelling Turbulence - Multiphase Flow and Combustion

### Major 2: Aerospace Systems and Control - 231 h

Multiple-Input, Multiple-Output systems - Control of flexible structures - Robust and optimal control - Systems identification and estimation - Non-linear control - Hybrid control - AI methods and tools for Automatic Control - Aircraft Power Architecture  
Aircraft & Space Actuation Systems - Preliminary Design Model & Sizing of Aircraft Air-conditioning Systems

### Major 3: Aerospace Structures - 204 h

Aeroelasticity & Flexible Aircraft - Aeroelasticity part  
Aeroelasticity & Flexible Aircraft - Flexible Aircraft part  
Aerospace Structures - Advanced Structural Dynamics Part  
Aerospace Structures - Composite Structures in Services Part  
Computational Solid Mechanics - Manufacturing  
Mechanics of materials - Space Structures: satellites & launchers

### Major 4: Embedded Systems - 241 h

Architecture and Programming of Software Systems  
Real-Time Systems - Model-Based System Engineering  
Real-Time Networks - AI and Autonomous Systems  
Architecture, Design and Synthesis of hardware systems  
System Dependability - Certification

### Major 5: Space Systems - 275 h

Space environment and effects - Mission analysis and orbital mechanics - Space communications systems - Space project: tools for simulation - Space systems architecture: ground segments, satellites & sub-orbital planes - Launchers architecture - Satellite propulsion: chemical & electrical - Satellite AOCS - Launchers guidance and control - Satellite electrical systems  
On board data handling sub-systems: functions and architectures  
Satellite thermal control systems - Estimation and filtering

### Major 6: Space Imaging, Navigation & Communication- 233 h

Random signal processing and estimation - Electromagnetism applied to avionics - Satellite-based navigation - Wireless systems, microelectronics, microwave, and optronics - Satellites and orbits - Digital communication basics - Remote sensing and sensors - Satellite broadcasting - Broadband satellite communication systems

### Major 7: Systems Engineering - 225 h

Requirements Engineering - Systems Engineering Data Technical Management - Systems Modelling and Analysis - Systems Dependability - Systems Design and Architecture - Introduction to Verification & Validation - AIRBUS study case: Systems Engineering & Certification of the A350

### Research project : 150 h

## SEMESTER 4: 30 CREDITS

Students conduct a thesis in industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE. The Master thesis is concluded by the writing of a report and a public defense.

## ■ Pathway Aircraft

### Design and Operation

Students attending majors Aerospace structure and Aerospace system and control can follow the pathway Aircraft Design and Operation.

In this case they attend two dedicated modules, in semester 2, and they perform their research project in this field.

## ■ Foreign language

During the two-year program, students attend «French as foreign language» classes, in order to become independent users.

This gives graduates a clear advantage when applying for high level engineering positions in the Aerospace industry as they are able to understand and express themselves clearly in three languages: English, their native language and French.

## ■ Organization

### Head of program

- Prof. Didier DELORME  
didier.delorme@isae-superaero.fr

### Head of program major Advanced Aerodynamics and Propulsion

- Prof. Erwin-Ricky GOWREE  
Erwin-ricky.GOWREE@isae-superaero.fr

### Heads of program major Aerospace systems & control

- Prof. Valérie BUDINGER  
valerie.budinger@isae-superaero.fr
- Prof. Yves BRIERE  
yves.briere@isae-superaero.fr

### Head of program major Aerospace structures

- Prof. Patrice LONGERE  
patrice.longere@isae-superaero.fr

### Head of program major Embedded Systems

- Prof. Ahlem MIFDAOUI  
alhem.mifdaoui@isae-superaero.fr

### Head of Program major Space systems

- Prof. Stéphanie LIZY-DESTREZ  
stephanie.lizy-destrez@isae-superaero.fr

### Head of program major Systems engineering

- Prof. Jean-Charles CHAUEMAR  
jean-charles.chaudemar@isae-superaero.fr

### Head of program major Space Imaging Navigation & Communication

- Prof. Damien ROQUE  
damien.roque@isae-superaero.fr
- Prof. Marjorie GRZESKOWIAK  
marjorie.grzeskowiak@isae-superaero.fr

### Duration of studies

Two year full time

### Beginning of classes

September

### Location

ISAE-SUPAERO

### Teaching language

English

1<sup>ST</sup> YEAR

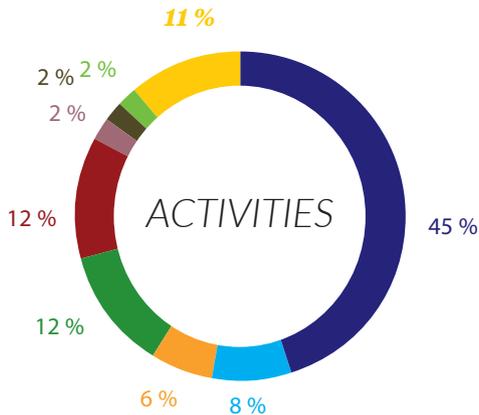
2<sup>ND</sup> YEAR



INDUSTRY PLACEMENT (OPTIONAL)

■ Career opportunities

**77 %** Started their career in France  
More than 68% work in Toulouse area



- Research and development
- Studies, Advisory and Expertise
- IT
- Maintenance and Support
- Method, Production Control
- Industrial property, licence, certification
- Manufacturing
- Purchasing, Supply, Logistics

■ Main Companies recruiting our students

AIRBUS, EXPLEO, AKKA ALCIMED, ALTRAN ATOS, THALES ATR, ALTEN BCG, EXPLEO, ALCIMED, ATOS, ATR, BCG  
... and many other companies, governmental bodies, universities and research centers all over the world.

ISAE-SUPAERO / TUM double degree in Aerospace Systems Engineering

Technical University of Munich (TUM) and ISAE-SUPAERO share the excellence of their education and research activities to offer a double degree in Aerospace Systems Engineering. Interested students will have to apply for ISAE-SUPAERO MSc Aerospace Engineering and motivate their intention to participate in this double degree program. The first year will be performed at TUM in MSc Aerospace Systems Engineering. The second year will be performed at ISAE-SUPAERO in MSc Aerospace Engineering - major Systems Engineering





## Testimonies

### ROSANGELICA CARDENAS SIERRA

Campeche, Mexico  
Major Aerospace Structures



The reason why I chose the MSc in Aerospace Engineering in ISAE-SUPERO is because it is a 2 years international program which involves you in the research and/or professional environments with the possibility to adapt the academic plan according to your personal interests.

In my case, I selected the Structures Major and performed an internship about Topology Optimization in Airbus.

Afterwards, I was hired in this company as a Structure Analysis Engineer and since then, I have been collaborating in Research & Technology projects as well as In Service activities.

Additionally, I am a temporary-professor in ISAE-SUPERO and in my free time I perform non-profit voluntary activities to underscore the importance of education.

### OLIVIA DRAYSON

London, UK  
Major Space systems - Graduated in 2019



I chose ISAE Supaero because of its reputation as a leading institution in aerospace engineering and its location in the aerospace hub of Europe. I also relished the opportunity to learn French and immerse myself in the French culture. I chose the Space Systems major as I knew I was more passionate about space systems than aeronautical systems and I liked the breadth of study that the Space Systems major provided.

I performed my 2nd-year internship with Space Applications Services, a Belgian company that, amongst other projects, developed the ICE Cubes platform onboard the ISS. My internship was primarily a continuation of my ICE Cubes Project as part of ESA Education's first Orbit Your Thesis programme. The cube that we developed is a test-bench for studying blood flow within a stented coronary artery on the ISS. Now I am pursuing a doctoral degree at the University of California Irvine, studying the impact of space radiation on the brain.

### AKSHAY GUPTA

India  
Major Aerospace structures



I chose ISAE-SUPAERO, as it is one of the best aerospace schools in Europe, and Toulouse is the home of Airbus. The amount of expertise ISAE-SUPAERO possesses in R&D, and the relations with the aerospace industry is the key factor, which makes ISAE-SUPAERO a unique institution. Also, I like to learn languages, and here I could learn French. I studied Aerospace Structures major and performed a research project on Multi-disciplinary Optimization of Flying Wing configuration aircraft.

For my internship, I worked at an innovation space of Airbus known as ProtoSpace. I worked with MIT (USA) on structural morphing for a demonstrator aircraft of Airbus. At the same time, I also managed the innovation portfolio of ProtoSpace with my manager. After my internship, I continued to work at ProtoSpace as an Aerospace Innovation Engineer.

### MIRO LJUB MILADINOVIC

Serbia  
Major Advanced aerodynamics and propulsion



I chose ISAE - SUPAERO for school's reputation, structure of the M.Sc. program and SUPAERO's location. I opted for major in Advanced Aerodynamics and Acoustics. During studies, I did the research project «Numerical study of an aircraft trailing vortex». Both the major and the project gave me a chance to make strong foundations and acquire knowledge needed for research and industrial work.

- I did the final year internship in the research department of PSA Group and S2A wind tunnels complex. Topic of the internship was car wheels aerodynamics, where theoretical, numerical and experimental studies were done in order to reduce vehicle drag caused by wheels. By now, I am working in Air France Industries as Structures Engineer on Boeing 777 fleet.



# ADVANCED MASTERS

Advanced Masters in the fields of engineering and management are one year degrees taught in English or French.

“Advanced Master” is a specialisation label from the Conférence des Grandes Ecoles (France’s top-ranking Engineering Colleges). The rigorous accreditation procedure of the latter guarantees program quality. The aeronautical industry is looking for more and more engineers capable to manage complex and technical projects.

Thanks to its close links with the aerospace industry, ISAE-SUPAERO develops, enriches and adapts an innovative training portfolio in order to offer highly

employable experts in response to the growing demands of this industry.

These courses are supplemented by tutorials, case studies and team projects, completed by a semester in a company and the realization of a professional thesis.

ISAE-SUPAERO offers advanced master’s degrees in aeronautic & space, systems engineering, management and financial engineering.

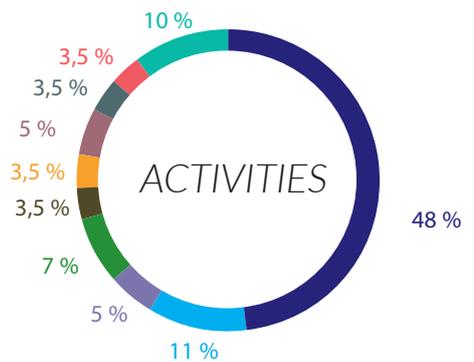
Main companies recruiting our students :

AIRBUS , ALTRAN , SAFRAN, AVIC, AKKA, THALES, DGA EV, SOGETI HIGHTECH, ALTEN, ASSYSTEM, FLYING WHALES

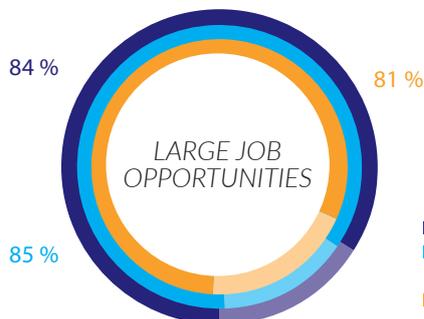


## EXCITING CAREER PERSPECTIVES

### BUSINESS AREAS



- Research and Development
- Studies, Advisory and Expertise
- Informatics
- Maintenance and Support
- Administration, Management Dpt, Finance, Accounting
- Quality and Security, Operational Safety
- Methods, Production Control
- Supply chain
- Marketing
- Others



- Permanent contract
- Hired less than 2 months after obtaining the degree
- Started their career in France





AERONAUTICS

## MS TAS AERO

### Aeronautical Engineering Majors Aircraft Design /Flight Test Engineering



#### ■ Objectives

The Advanced Master TAS AERO program is dedicated to Aeronautical Engineering and Human Factors. The program includes a common core and one of the following majors : either one focusing on Aircraft Design process and Engineering (TAS AERO-ADE) or the other focusing on Flight Test Engineering (TAS AERO - FTE). The TAS AERO Advanced Master enables students to develop a high level of expertise in engineering science, human factors, current aeronautical technologies and design.

The TAS Aero curriculum includes a broad spectrum of subjects with the following objectives:

- to develop an integrated approach of the product design, while acquiring necessary skills in the disciplines and techniques predominant in the aeronautical sector,
- to make future engineers aware of human factors issues,
- to facilitate work on multidisciplinary projects in aeronautics with a very practical approach,
- to develop skills in project-management, team building and team process at a multinational level,

The major in Aircraft Design Engineering – ADE -focuses on process and tools required during all Design phases from Conceptual to Detailed Design.

The major in Flight Test Engineering - FTE - focuses on the tests to be conducted during aircraft and equipment development and certification.

#### ■ Learning approach

##### First semester:

Academic session of around 430h, provided by ISAE's permanent professors and experts from aerospace industry bringing current knowledge and experience, including:

- lectures, exercises,
- engineering and design study seminars,
- laboratory sessions,
- written report and oral presentation,
- practical sessions,
- team work and team business games,
- in-flight practical experiment and industrial visits (Airbus, DGA Flight Test, Liebherr...).

##### Second semester:

Students have to conduct a professional thesis in aerospace industry or in laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of jury.

#### ■ Organization

##### Head of program

- Prof. Éric POQUILLON  
eric.poquillon@isae-supero.fr

##### Course duration

One year full time : 6 months of courses and 6 months of professional thesis or internship.

##### Course start date

September

##### Location

ISAE-SUPAERO

##### Teaching language

English

#### ■ Career opportunities

More than 1100 students from 55 countries have been trained over the last 30 years and now work as research engineers, designers, project managers, program managers, and consultants, in companies such as Airbus, DGA Essais en Vol, AKKA, ALTRAN, MBDA, Dassault, ArianeGroup...



© S.A.S. AIRBUS 2016 - photo by H. Goussé/master films

## Syllabus

Detailed Program	Hours	TAS AERO Aircraft Design	TAS AERO Flight Test
<b>STRUCTURES AND MATERIALS</b>			
<i>Aircraft Structures</i>	50	✓	✓
<i>Materials for Aerospace structures</i>	15	✓	✓
<b>FLIGHT PHYSICS</b>			
<i>Aerodynamics</i>	40	✓	✓
<i>Propulsion</i>	20	✓	✓
<i>Flight Dynamics</i>	35	✓	✓
<b>AVIONIC AND SYSTEMS</b>			
<i>Aircraft Systems</i>	35	✓	✓
<i>Flight Control laws</i>	20	✓	✓
<i>Human Factors I</i>	50	✓	✓
<b>FLIGHT TEST ENGINEERING MAJOR</b>			
<i>Flight test technics and methods</i>	30		✓
<i>Human factors II</i>	46		✓
<i>Flight test experimentation</i>	55		✓
<i>Experimental Flight Dynamics</i>	15		✓
<i>Measure and Sensors</i>	12		✓
<i>Flight Test Final project</i>	17		✓
<b>AIRCRAFT DESIGN ENGINEERING MAJOR</b>			
<i>Propulsion Systems</i>	20	✓	
<i>Modeling for aeronautical structures</i>	25	✓	
<i>Computer Aided Design (CATIA)</i>	18	✓	
<i>Aircraft Performances</i>	25	✓	
<i>Aircraft Design</i>	28	✓	
<i>System Engineering</i>	10	✓	
<i>Multicultural project management</i>	12	✓	
<i>Aircraft Design - Final project</i>	29	✓	





## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS ? What were your objectives ?

**CLAIRE BRACA**  
Graduated in 2018  
Engineer - DGA flight tests

☞☞ I chose ISAE SUPAERO because it has a very good reputation in the aeronautical industry. With this generalist TAS AERO program, my goal was to specialize, reinforce and acquire skills in aeronautics in order to broaden my possibilities to work for large companies in this industry.

Moreover, I have always been passionate by flight tests, as they can combine both theory and practice in aeronautics.

**FRANÇOIS PERRINEAU**  
Cohort 2018/2019  
Flight Test Analysis Engineer - Airbus

☞☞ I am graduated from a general engineering school (EPF) where I specialized in aeronautical mechanics. During my last year of study, I did my final-year project in the Flight Test & Integration Center department at Airbus Toulouse where I was responsible on aircraft simulators. From this experience and strongly encouraged by my Airbus managers, I integrated the Advanced Master TAS AERO FTE at ISAE SUPAERO. I came to develop my knowledge especially in flight testing but also in human factor, aerodynamics and structure. The program follows a common core with the MS TAS AERO Aircraft Design and flight tests with experiments on the various light aircraft of SUPAERO.

### According to your experience, what are the strong assets of the Advanced Master ?

Thanks to the TAS AERO FTE advanced master, I have:  
acquired general expertise in aeronautics and specific expertise in flight tests, applied the theoretical courses in real life thanks to the case studies,  
acquired as many expertise in fixed wings as in rotary wings, from a general aeronautic point of view as well as in the flight tests.

We were teams of 3 FTE (Flight Test Engineer), we flew a dozen times on 3 different planes with the help of 2 Experimental Test Pilot, Etienne and Stéphane. During these flights, we focused on airspeed calibration, aircraft climb and cruise performance, stability, handling qualities, engine failure, stall, acceptance flight. Concerning the flight test course and the common core, the program is rich and presented by speakers from the aeronautics industry (Airbus, Dassault, DGA, EPNER) accompanied by company visits and laboratory experience (engine bench tests and aerodynamic wind tunnel at SUPAERO).

We also had the opportunity to go for 2 days to the flight test center at Istres base where we visited fighter aircraft such as Rafales, Mirage 2000D and Alfaqet. It was a very rewarding experience that will be engraved for life.

Thanks to Prof Eric Poquillion (Head of FTE) for his rich expertise in flight testing and certification, himself a graduate of EPNER (French Test Crew School) and Anne Forget for her work, she keeps us informed of any unexpected changes and answers emails even on weekends!

I will conclude that the FTE Advanced Master is very valuable both on a personal level and in terms of learning and developing the skills of the flight test engineer profession.

### What are your career plans ?

I now work within the operations activities for DGA EV (Direction Générale de l'Armement - Essais en Vol) in Istres. I have acquired many specific and cutting edge knowledge on flight tests. In the mid-term, my goal would be to supervise a flight test. This requires numerous technical knowledge that we usually acquire during a second professional experience.

At the end of the advanced master, I found a permanent contract at Airbus Flight & Integration Tests in Toulouse. I am responsible for the analysis of flight tests in aerodynamics, load and stress activities. My work is very recent, but I'm taking care of the preparation of Airbus flight test campaign, monitoring the measurements in real time in telemetry and providing the necessary support to the flight crew.

These activities are similar to those performed during the FTE Advanced Master and also which helped me to get this job.

Further, my career plan is to implement new technologies, manage projects, prepare and support future changes in development & testing of aircraft.



## ■ Objectives

In an increasingly competitive international context, the research on innovative materials combined with optimization of calculation methods for structures, and their statistical, dynamic and thermal certification are major assets for industrial architects in the aircraft and spacecraft sectors. The «Aeronautical & Space Structures » prepares engineers with a future career in design, research and development, certification, testing and qualification, in-depth, multi- disciplinary know-how in mechanical engineering applied to structures. This Master program is the european reference in the field.

The program aims to grow expertise in numerical calculation for the most advanced structures, knowledge in materials as well as an understanding of their interferences with the environment (in particular loads and fluid-structure interactions).

The dynamics of flexible structures, modeling and active and passive structural control of complex elements are the core focus of this master program.

The goal of the AES Advanced Master program is to train specialists in the field of design, optimization and certification of light structures who have mastered methods of modeling and analysis of aircraft structures and space vehicles in the industrial context.

## ■ Learning approach

### First semester:

380 hours of courses delivered from September to March on the premises of ISAE by permanent ISAE-SUPAERO faculty and visiting lecturers from industry providing the latest industrial expertise including: lecture courses, design offices, lab work, numerical simulations, CAD, lab sessions, industrial visits.

### Second semester:

Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

## ■ Organization

### Head of program

- Prof. Yves GOURINAT  
yves.gourinat@isae-supaeo.fr

### Course duration

One year full time : 6 months of courses and 6 months of professional thesis or internship.

### Course start date

September

### Location

ISAE-SUPAERO

### Teaching language

English

## ■ Syllabus

### Part 1: Aerospace structures: methods & tools for engineering & dynamics - 62 h

- Flight dynamics: an introduction
- Aerodynamics: an introduction
- MATLAB standards
- Structural dynamical control: an introduction
- Structural shells modeling and recycling
- Advanced numerical models

### Part 2: Aerospace systems architecture - 82 h

- Aerodynamics loads
- Aircraft structural loads
- Architecture & structure of launch vehicles
- Helicopters: architecture & design
- Satellites: architecture & structures

### Part 3: Aerospace structures: dynamics & physics - 138 h

- Finite elements: application to aeronautical structures
- Flexible aircraft: dynamics & aeroelasticity
- Dynamical active control of structures
- Advanced computation of aircraft structures
- Advanced structural dynamics

### Part 4: Aerospace programs & technologies - 75 h

- Mechanics of aerospace materials
- Computer Assisted Design & Drawing
- Commercial aircraft: strategies for design & innovative programs

### Times project - 25 h

Team Innovative Management for Evolved Strategies

## ■ Career opportunities

This program, unique in Europe, has trained over 170 engineers. Today, graduates of the program are working as research or design engineers in international companies in the aeronautics, space and mechanical engineering sectors.

The advanced scientific level of the MS AES program also paves the way for career opportunities in research in solid mechanics and structures.

### Companies recruiting our students

Aerazur, Airbus Group, Altran, Astek, ASSYSTEM, ATKINS, AXS Analyse de Structures, Air France, CLAIRIS TECHNOLOGIES, Dassault Aviation, DLR (Germany), ESA, Latecoere, SAFRAN Engineering Services, Segula, Sodern, Sogeti, Thales, Thales Alenia Space, Renault, PSA, ...





## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS ? What were your objectives ?

#### HUGO DE BASTOS

Graduated in 2019  
Engineer in Aerodynamic studies at ArianeGroup

I Choose ISAE-SUPAERO because it's one of the most important school in aeronautic and aerospace engineering. The proximity and the relation of the school with Aerospace industry also were an advantage I took in consideration. I apply to the MS "Aeronautical and Space Structure", because it cover many aspect of mechanics in aeronautics and space domain. My objectives were to get a different view of engineering than my previous school, I also wanted to improve my knowledge in mechanics to have a complete education.

#### MENELAOS FILIPPITZIS

Cohort 2019-2020  
AIRBUS Trainee / Flight Physics department / Loads and aeroelastics

Having finished my studies in Mechanical engineering in Greece I wanted to enhance my knowledge and passion for aerospace and specialize in the domain of aero structures. After performing an exhaustive survey of schools and master degrees available, all the roads were pointing towards ISAE-SUPAERO. The accuracy of the syllabus, coupled with the professional and industry oriented character of this Master gave me the confidence that it was what I was looking for. Last but not least, you get the chance to live in one of Europe's most beautiful and cool city, Toulouse!

### According to your experience, what are the strong assets of the Master ?

Firstly, this Advanced Master meet my expectations, because I learned a lot in mechanics and the way to approach engineering was different.

Then, the strongest assets of this Master are the personnel and the teachers. For many of them, the classes were a dialog with the teachers (for example during Yves Gourinat's lessons), which was very interesting and helpful for the young engineer we were. The quality of the courses also was a very good point and many of us discovered unexpected affinities for some of the disciplines in Aeronautics and Space engineering.

The specialization and expertise offered by the AES Master, the well organized study plan, the quality and performance of the teachers and experts, all together make it one of its kind. The opportunity given to the students to listen, learn and discuss with experts from the industry and the companies they are willing to work for is a huge advantage. Not to mention that acquiring a ISAE degree, automatically certifies and assures all recruiters in the aerospace sector that your profile must be shortlisted and taken into account.

### What are your career plans ?

My first plan was to work in Space industry, in mechanics studies, which is a success. In the future I would like to see many different technical aspect, to try to work in a foreign country or/ and in French Guiana.

After my internship in AIRBUS SAS I am willing to explore the space sector and implement all the skills acquired from the AES Masters. The aerospace sector is a significantly up coming domain and Toulouse has a lot of interesting opportunities for passionate engineers.





AERONAUTICS

## MS AMS-E&M

# Aeronautical Maintenance and Support Engineering & Management



### ■ Objectives

Aeronautical maintenance and support ecosystem is a highly competitive and dynamic international environment, facing exciting commercial, economical, strategic and technical challenges, with constant safety concerns.

Encompassing a wide range of complex activities (concurrent engineering, operability analysis, integrated logistics support, lifecycle management, line-base-shop maintenance, repair, modification, support services, supply chain services), it plays a key role for defence and civil aviation. It aims at designing, managing and ensuring aircraft continuing airworthiness and safety at acceptable costs with the best availability, while benefiting from technological innovations to create added-value for stakeholders.

The Advanced Master AMS-E&M delivers the appropriate high-level competencies and know-how in aircraft architecture, maintenance and support delivered by experts, with an exposure to latest techniques and methods, know-how, innovation, regulations and standards applied through this value chain. It prepares attendees to join successfully the competitive and fast changing Maintenance & Support worldwide business.

### ■ Learning approach

#### First semester:

Academic session of courses from September to March. 450 h of lectures, projects, tutorials, practical sessions, visits of aeronautical industries.

#### Second semester:

Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.



### ■ Organization

#### Head of program

- Prof. Joël JEZEGOU  
joel.jezegou@isae-supaero.fr

#### Course duration

One year full time : 6 months of course and 6 months of professional thesis or internship.

#### Course start date

Mid September

#### Location

ISAE-SUPAERO

#### Teaching language

English

### ■ Syllabus

#### Part 1: Aircraft General Familiarization

Aircraft architecture - Structure & Materials - Aircraft General Systems - Avionics - Engines and Powerplant.

#### Part 2: Maintenance and Support in Aircraft Design

Operability and Maintainability Influence on Design - Integrated Logistic Support (ILS) and Logistic Support Analysis (LSA) - Configuration Management - Development and evolution of a maintenance program (MSG-3) - Ground Support Equipment Project LSA/ MSG-3

#### Part 3: Maintenance & Health Management Analysis & Modelling

RAMS techniques and modelling - PHM, Predictive maintenance and data analytics.

#### Part 4: Maintenance Execution & Management

Engines maintenance - Systems troubleshooting - Equipment maintenance - Organization and management of a maintenance department - Military maintenance organization - Project MRO.

#### Part 5: Airworthiness, Safety & Human Factors

Aviation regulation, airworthiness and Safety analysis - Continued & continuing airworthiness - Human Factors and MRO Safety Management System.

#### Part 6: Customer Support

Customer support and services. Aircraft financing and Stakeholders liability.

#### Part 7: Supply Chain & Recycling

Supply chain Airlines economics and liabilities.

## ■ Teaching staff

Teaching staff is composed of ISAE-SUPAERO's permanent professors and experts from aerospace and aviation industry with aeronautical industrial background (Airbus, Air France, Dassault Aviation, ATR, Sabena Technics, Safran, AKKA Technologies, Star Engineering).

## ■ Career opportunities

Engineering or management position in aircraft-engines-components manufacturers (OEM) and suppliers, airlines, approved maintenance organizations, continuing airworthiness management organization (CAMO), in-service support departments, OEM, supply chain organizations, authorities in civil or military aeronautical industry.

## ■ Example of positions

Maintenance engineer or manager, maintainability/operability engineer, product support engineer, logistic support engineer.

### Companies recruiting our students

Air France Industries, Airbus, Dassault Aviation, French Navy, Sabena Technics, ATR-Aircraft, Groupe ORTEC, Star Engineering, AKKA Technologies, SII, SAFRAN AIRCRAFT ENGINES, Sopra Steria, COMAC (China), AVIC (China), Singapore Air Force, ...



## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this Advanced Master What were your objectives?

**LUCIE BONNAURE,**

Graduated in 2018

GE90 powerplant engineer - Air France KLM E&M



I choose ISAE-SUPAERO to realize an advanced master because it was for me the insurance to have a formation of quality. I also knew a former student from my school who did this same master two years before and who told me about it. I choose the AMS advanced master because I wanted to work in the civil aeronautical maintenance industry and by reading the

program of the courses before to apply, I found it very complete and interesting (a lot of technical subjects but also courses about the regulation and about aircrafts airworthiness which I knew not much about).

My main objective was to learn as much as I could and to find an internship in an aeronautical maintenance company that could directly lead to an employment afterwards within a maintenance department (service manager).

### According to your experience, what are the strong assets of the Master?

I think the strongest asset of this master is to propose a large range of different subjects around the aircraft maintenance. It is also the occasion to meet a lot of professionals from different sectors.

When you are looking for a job it gives you a pretty good idea of what it is possible to do.

### What are your career plans?

I am a part of a program for young employees for a 4 years duration so in the short term I intend to stay in the same company. After that, I would be interested to work abroad depending on the opportunities!



# Aviation Safety: Aircraft Airworthiness

(ISAE-SUPAERO / ENAC / ECOLE DE L'AIR)



## ■ Objectives

Airworthiness plays a pivotal role in aviation safety and development, guaranteeing that design, manufacture, operation and maintenance of aircraft, engines and systems are suitable for safe flight. It is supported by an overall process for which a solid regulatory and technical knowledge is necessary.

The Advanced Mastere ASAA provides the required high-level skills and competencies in the fields of airworthiness regulations, aircraft and systems design and certification, continued airworthiness and operation. It has been designed to meet industry and authorities demand for airworthiness or certification engineers specific profiles.

To further improve safety within a growing aviation industry, and to efficiently and safely introduce in the skies new technologies and innovative aircraft architectures, this program delivers relevant methodologies and keys to enhance certification approaches for civil and military aircraft.

## ■ Learning approach

### First semester:

Academic session of courses from October to March. A well-structured progressive approach through lectures, projects, tutorials, visits of aeronautical industries, up to an Integrated Team Project to apply learnings on job-based situations.

### Second semester:

Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO or ENAC or Ecole de l'Air. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

## ■ Organization

### Head of Program ISAE-SUPAERO

- Prof. Joël JEZEGOU  
joel.jezegou@isae-supaero.fr

### Head of Program ENAC

- Pascale PUEL  
pascale.puel-ext@enac.fr

### Head of Program École de l'Air

- Florent BASTIEN  
florent.bastien@ecole-air.fr

### Course duration

One year full time: 6 months of courses and 6 months of professional thesis or internship.

### Course start date

End of september

### Location

ISAE-SUPAERO (Toulouse), Ecole Nationale de l'Aviation Civile (ENAC) (Toulouse), Ecole de l'Air (Salon-de-Provence)

### Teaching language

English

## ■ Syllabus

### Part 1: Certification Procedures - 78 h

- Certification Procedures
- Change to Type Certificate

### Part 2 - Transverse Certification Items - 88 h

- Safety and Design Requirements for Systems
- Environmental Certification
- Human Factors
- Normal-Category Aircraft

### Part 3: Aircraft Certification - 183 h

- Flight
- Structure
- Avionics
- General Systems & Cabin
- Normal-Category Aircraft and Unconventional Products Certification

### Part 4: Integrated Team Project (ITP) - 62 h

- Certification Plan ITP
- Safety and Regulatory Intelligence ITP

### Part 5: Continuing Airworthiness and Operations - 43 h

- In-Service Occurrence Management
- Continuing Airworthiness
- Operations & Operational Certification

### Part 6: Airworthiness of State Aircraft - 30 h

- Airworthiness of State Aircraft

## ■ Career opportunities

The program fully matches job market expectations for certification or airworthiness engineer positions. It offers a wide range of job opportunities within civil or military aircraft – engines – systems manufacturers, suppliers, airlines and aviation safety authorities.

### Companies recruiting our students

Aeroconseil, Airbus, Air France, ATR Aircraft, Dassault Aviation, DGAC, Assystem technologies, AKKA Technologies, ALTEN, SII Group, National Aviation Authorities, EASA, Transport Canada, French Ministry of Defence, Brazilian Air Force, Flying Whales, COMAC (China), AVIC (China), Lilium GmbH (Germany), AMAC Aerospace (Switzerland), Embraer (Brazil), Hal (India), Blue Bird Aviation (Kenya), Pipistrel (Slovenia)





## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS?

**SOPHIE LE QUELLEC ,**

Graduated in 2018

Avionics Airworthiness Engineer - Airbus



I am a General Engineer, having graduated 20 years ago.

Throughout my career, I have had the opportunity to work in high standards industries in Naval

Defense and Space. Reaching mid-career and being strongly attracted by aeronautical matters, I decided to be trained in the best aeronautical schools, ENAC and ISAE-SUPAERO in order to get a reputable diploma allowing me to apply to interesting job positions in aeronautics.

### What were your objectives?

My first objective was to get a comprehensive understanding of aircraft design and the link with Aviation regulations.

I also wanted to work in an environment where I can mix

multidisciplinary technical aspects, regulations, team working, negotiation and contribute to aviation safety.

### According to your experience, what are the strong assets of this master?

The lectures were at a very high level of knowledge, quite intensive and very comprehensive, mostly given by experts coming from aircraft industries. I highly appreciated the

multicultural environment with classmates from all over the world.

### What are your career plans?

Thanks to this master, I was able to get immediately a job as a Certification Team Leader, working on avionics major modifications on AIRBUS aircraft. My mid-term goal is to join

an aircraft manufacturer and to be part of the team who will get the certification of a new or modified aircraft.



**MS HADA****Helicopter, Aircraft and Drone Architecture**

WITH AIRBUS HELICOPTERS

**Objectives**

The Advanced Master's course in "Helicopter, Aircraft and Drone Architecture (HADA)" is jointly designed and developed by ISAE-SUPAERO and Airbus Helicopters. This 2-semester program provides a high-level of engineering and technical skills for careers in the aircraft, helicopter and drone industries.

This new program provides the basic skills required for aeronautical engineers (architecture, certification and structures) and specific skills to identify problems, come up with alternatives, choose and implement solutions to aircraft, helicopter and drone projects. Drones and Urban taxis will be developed as they represent a growing part of the activity in the future aerospace sector. Industrial, regulatory and logistical challenges will therefore emerge. As a result, future aerospace engineers interested in being part of these innovative projects will need to call on and develop new skills and expand their current knowledge. This program offers full training from electronic systems to structures and taking in aerodynamics, flight dynamics and certification while encouraging and taking into account the diversity in the profiles of selected applicants.

This ADVANCED MASTER course takes into account cutting edge techniques required for future aircraft and rotorcraft systems including the new challenges associated with urban mobility. The present program is a high level Master course recognized by industry and adapted to current and future aeronautical engineering.

**Learning approach****First semester:**

Academic session from September to March, provided by the tenured professors at ISAE-SUPAERO and aeronautical industry experts with their updated knowledge and experience (Airbus Helicopters, Airbus Group, Safran/Turbomeca, Thales, etc.). Including: lectures, tutorials, and practical sessions.

**Second semester:**

Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a thesis committee.

**Organization****Head of program**

- Prof. Jean-Marc MOSCHETTA  
jean-marc.moschetta@isae-supaero.fr

**Course duration**

One year full time : 6 months of courses and 6 months of professional thesis or internship

**Course start date**

September

**Location**

ISAE-SUPAERO from September to January, Airbus Helicopters site (Marignane) from February to March

**Teaching language**

English

**Syllabus****Part 1: Aircraft structures, Aircraft architecture and certification - 100h**

Aircraft architecture - Certification - Computer Aided Design  
Aircraft Structures

**Part 2: Fixed-wing Aircraft - 130 h**

Engines and powerplant - Aircraft general -systems - Avionics systems - Flight dynamics

**Part 3: Helicopters - 150 h**

Helicopter: Aerodynamics, performance and flight qualities  
Helicopter dynamics - Helicopter materials and construction technics - Helicopter Systems: prototyping, tests and production quality

**Part 4: Drones - 120 h**

Designing drone systems - Payload and sensors for UAVs - Drone safety and airworthiness - Drone guidance and navigation - Neutral network for control and diagnostics

**Career opportunities**

This program prepares participants for a wide range of professional opportunities from design, certification and operation of civil and military aircraft, drones and helicopters in France and overseas.

**Companies recruiting our students**

Altran, Airbus Group, Airbus Helicopters, Safran-Turbomeca, Thales, Dassault Aviation, Gendarmerie Nationale, Helibras (Brazil), AVIC (China) HAL (India), Pawan Hans Helicopters ltd (India), Airbus Helicopters Mexico, Algerian Air Force, Brazilian Navy, Chile Air Force, Indian Air Force, Pakistan Army, Tunisian Air Force, Sauber f1 team...





## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS ? What were your objectives ?

**ESTELLE CADARS**  
Graduated in 2019

During my studying in engineering school in apprenticeship, I have worked in Airbus Helicopters. After this experience I was determined to work in a helicopters company as an engineer but I didn't have any technical background. ISAE is the most famous school to learn about aeronautic, so it was the best solution to fill my wish. I have chosen the Master HADA because it's the only one with helicopters lessons and it's a general one without any specialization so it has allowed me to have a good perception of different kind of jobs.

**JULIEN VOIRIN**  
Structural Design Engineer - Dassault Aviation  
Graduated in 2019

Coming from a non-specialized engineering school, INSA Rouen Normandie, and being really fascinated by flying systems, for me it was obvious to apply for ISAE Supaero which is one of the best engineering school in the aeronautical field, in France. Therefore, I was sure that this school would open many doors for my future career. MS HADA perfectly met my expectations since my goal was to discover and learn all about flying systems. My second interest was to have a first contact with an innovative and new system : Drones.

### According to your experience, what are the strong assets of the Master ?

The strongest assets of this master are: the quality of the lectures taught by specialist engineers from several companies. They are passionate about their jobs and they don't hesitate to take time to transmit us their experiences. It gathers all fields regarding aircraft, drone and helicopters (regulation, design, dynamics, avionics, systems, performance etc). And then, there are lot of visits planned in several companies in Toulouse and in AH in Marignane.

The strong assets of MS HADA master are numerous: the proximity with industries (experience at Airbus Helicopters), with teachers/engineers who were really easy to interact and always there to dedicate their time in moments of need. The fact we obtain an overview of all the systems in three different categories (planes, helicopters, drones), that companies value this program, giving us a chance to find good internships and opening the gates for the best jobs out there. And last, but not least, the fact that this master is entirely taught in english.

### What are your career plans ?

I have been lucky to perform my internship in Airbus Toulouse in the Flight Test department. My plans after graduation is to join AHD for two reasons: I always wanted to work as a flight test engineer for helicopters, and thanks to this Master I have discovered the drone area, so I hope I will work as well on the taxi drone project in Donauwörth !

I plan to stay to stay in the aeronautical domain. I want to continue working in the design office with dimensioning of aeronautical structures, as I'm doing during my internship at Dassault Aviation. My initial plan is to gain a strong technical luggage in mechanics and, throughout the years, be able to evolve in my career inside Dassault Aviation.



AERONAUTICS

## MS IEVEX

# Experimental Flight Test Engineering

(ISAE-SUPAERO / EPNER - THE FRENCH FLIGHT TEST SCHOOL)



### ■ Objectives

Under the aegis of the DGA, ISAE-SUPAERO and EPNER joined their expertise setting up the first Master's degree in Flight Test Engineering for pilots and engineers using the synergy of their recognized competences in aerospace education.

EPNER is one of the world leader Flight Test School offering high-level courses for Flight Test Pilots and Flight Test Engineers. EPNER offers fixed wing and rotary wing courses for test pilots and engineers.

ISAE-SUPAERO and EPNER studied and developed a comprehensive program integrating their competencies and existing courses to provide EPNER flight test courses attendants with a Master's degree Specialized in Experimental Flight Test Engineering of ISAE-SUPAERO besides the EPNER qualification.

The Experimental Flight Test Engineering Master is a 12-month course organized by ISAE-SUPAERO and EPNER aiming at providing either Flight test Governmental Organisations or Aircraft manufacturers with high-qualified test pilots and flight test engineers. Aware of the necessity to conduct flight tests program in close coordination between pilots and engineers, the original spirit of this program is to prepare pilots and engineers to work in integrated team.

The objectives of the Master is to develop theoretical and applied skills of experienced pilots and engineers for the preparation, implementation and report of flight tests either of aircraft or complex embedded-systems, in the best safety conditions. After graduation, these skilled professionals are able to participate to civilian certification of new or modified aircraft, to aircraft or equipment development program, to military acceptance program, either fixed-wing or rotary-wing.

The course is split into two periods:

- 2-month courses in basis sciences and French aeronautical communication skills organized at ISAE-SUPAERO campus, in Toulouse,
- 10-month Experimental Flight Test courses, for fixed wing or rotary wing for pilots and engineers, given at EPNER in Istres.

### ■ Organization

#### Head of program

- Prof. Éric POQUILLON  
eric.poquillon@isae-supaero.fr

#### Course duration

One year full time : 2 months of preparation courses and 10 months of technical courses

#### Course start date

June

#### Location

ISAE-SUPAERO and EPNER-Istres

#### Teaching language

French

### ■ Learning approach

Academic session consists of around 450h of ground and simulators courses, provided by ISAE-SUPAERO and EPNER's permanent professors and experts from industry bringing current knowledge and experience.

And around 110 flight hours on more than 20 airplanes for fixed-wing stream and 15 helicopters for the rotary-wing stream.

All along the program, students conduct professional theses, assessment of aircrafts or embedded-systems. These theses are concluded by the preparation of a report and an oral dissertation.



## ■ Syllabus

### ISAE-SUPAERO part

	International attendees	French attendees
Mathematics	✓	✓
Flight mechanics	✓	✓
Automatic control and aircraft control	✓	✓
Visits of companies	✓	✓
Advanced aeronautical French	✓	
Aeronautical phraseology	✓	✓
Aircraft preliminary design		✓
Human factors		✓

## ■ Career opportunities

The Master intends to prepare skilled professionals, pilots or engineers for:

- Managers of flight tests implementation, flight envelop extension of aircraft or embedded-systems in close cooperation with design and development offices
- Managers of flight tests centers.



### Testimonies

Why did you choose ISAE-SUPAERO and apply for this AM ? What were your objectives ?

**RICE WILLIAMS**  
Cohort 2019

👂 This course was the only option and a great way to practice the French language in the sector of aviation while refreshing math and science I hadn't seen in 10 years. I was hoping to get a head start for EPNER.

According to your experience, what are the strong assets of the master ?

They're aren't many language programs that have an aviation and science emphasis so this is a great way to refresh math, science, and learn the french words that go along with studying at EPNER.

What are your career plans ?

I hope to become a test pilot for the United States of America.

### EPNER part

Systems engineering introduction – Safety of flight tests

Basics of aerospace technics

Documentation, procedures applied in flight tests programs – Performances tests

Propulsion tests

Handling tests

Embedded-systems tests

Specific test (fixed-wind): flight envelop extension

Certification, acceptance, assessment, etc. – Specific test (fixed-wind): flight envelop extension - Specific flights, synthesis activities – Professional thesis

## ■ Admission procedure

Selection and admission by the French Ministry of Armed Forces, contact us for more detailed information.

### Companies recruiting our students

Flight Test Centres, Air Force, Navy, Army, Airbus Group and its subsidiaries, BWB Germany, Dassault Aviation, ESA, Canadian Flight test center...





AERONAUTICS

MS SPA

# Systèmes de Propulsion Aérospatiale



## Objectifs

Former des spécialistes moteurs capables de concevoir et d'utiliser des turbomachines aéronautiques et terrestres, des moteurs d'engins spatiaux, ayant une solide formation en mécanique des fluides et sachant adopter une approche systèmes complexes.

Acquérir des connaissances approfondies en aérothermique et technologie des systèmes propulsifs (turboréacteurs, turbines à gaz, statoréacteurs et moteurs fusées).

L'accent est mis tout particulièrement sur l'aérodynamique interne (turbomachines et combustion).

## Méthode pédagogique

### Premier semestre :

Environ 450 heures d'enseignement dispensées de septembre à avril dans les locaux de l'ISAE-SUPAERO par les professeurs permanents et par des experts et professionnels apportant les dernières connaissances de l'industrie dont : cours magistraux, bureaux d'études, travaux pratiques, visites de sites industriels, travail en équipe.

### Second semestre :

Les étudiants doivent réaliser une thèse professionnelle en entreprise ou dans un laboratoire, en France ou à l'étranger, supervisée par un tuteur de l'ISAE-SUPAERO et de la structure qui l'accueille. La thèse se finalise par la rédaction d'un rapport et la soutenance d'un oral devant jury.

## Programme d'enseignement

### Bloc 1 : Architecture globale des systèmes de propulsion - 114 h

Les grands enjeux aéronautiques - Etat de l'art de la propulsion aéronautique - Mission et Environnement des aéronefs - Conduite du vol et facteurs humains - Enquêtes accidents et réglementation - Conception moteur: De la mission à la spécification (civil et militaire) - Performances et cycles (on- et off-design) - Méthodologies de design et d'expérimentation - Intégration à l'aéronef (contraintes et tandem avion/moteur, focus nacelle et systèmes annexes) - Approche multidisciplinaire - Propulsion spatiale, chimique, électrique - Avants projets et innovations incrémentales et en rupture.

### Bloc 2 : Aérodynamique interne - 240 h

Turbulence, instabilité et transition - Computational Fluid Dynamics - Dynamique des fluides avancée (compressible et instationnaire) - Aéroacoustique- Aéroélasticité - Propulsion chimique et électrique - Écoulements diphasiques et combustion - Aérodynamique des turbomachines - Étude de cas en conception (d'une chambre de combustion ou d'un étage de turbomachine).

### Bloc 3 : Projet - 96 h

Intégrer toutes les dimensions d'un projet : composante technique, gestion de projet et gestion d'équipe.

## Organisation de la formation

### Chef de programme

- Prof. Guillaume DUFOUR  
guillaume.dufour@isae-supaero.fr

### Durée

Un an à temps plein : 6 mois de cours théoriques et 6 mois de thèse professionnelle ou mission en entreprise.

### Rentrée

Fin août

### Lieu

ISAE-SUPAERO

## Perspectives professionnelles

La plupart des ingénieurs issus du MASTÈRE SPÉCIALISÉ® occupent des postes de cadres supérieurs chez les motoristes ou avionneurs du secteur aéronautique et spatial, au sein de SSII ou encore dans le domaine de l'énergétique générale auprès d'entreprises publiques et privées.

La formation peut aussi permettre la poursuite en thèse doctorale.

### Les entreprises qui recrutent nos étudiants

AQYLON, ALTRAN, DGA, SAFRAN AIRCRAFT ENGINE, SAFRAN ENGINEERING SERVICES, AIRBUS GROUP, DAHER, ...





## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS ? What were your objectives ?

#### ARTURO VICEN-VERA

Cohort 2019-2020  
ISAE-Supaero - DAEP



I chose this MS for its reputation and because Supaero is the best aeronautics engineering school in France, with close ties to the industry. The MS SPA is closely related to my Master's Degree and I believe it is good way to enter the aeronautics sector.

#### LAURENT FIESCHI

Promo 2019/2020

Stagiaire au CEA en simulation numérique des écoulements.



Diplômé de l'ISAT en 2019 avec une formation orientée mécanique des fluides, j'ai souhaité approfondir mes connaissances dans le domaine en postulant au Mastère Spécialisé Systèmes de Propulsion Aérospatiale. Mon diplôme me permettait d'accéder au marché du travail mais je souhaitais acquérir des compétences supplémentaires afin de me démarquer dans le monde professionnel. Au-delà de la réputation internationale de l'école, le programme très complet proposé correspondait à mes attentes.

### According to your experience, which are the strong assets of the Master ?

This Advanced Master is a very complete program, and the lectures are given by specialists. It has given me a very wide view of what the challenges are today, and how the sector might evolve in the near future.

Le programme est très bien construit autour d'enseignants maîtrisant parfaitement leurs sujets et d'industriels de renom (AIRBUS, SAFRAN, ARIANEGROUP, ONERA, etc.) intervenant très régulièrement tout au long de l'année. Cette diversité dans les acteurs de la formation sensibilise à la fois au monde de la recherche et de l'industrie.

Outre la qualité de l'enseignement, les étudiants sont confrontés à de nombreux cas pratiques plus ou moins complexes (BEs, Etude de cas en conception, Projet Ingénierie Entreprise) offrant la possibilité de concrétiser les apports théoriques ainsi qu'un bagage technique directement applicable à l'issue de la formation.

Actuellement en stage dans le domaine de la simulation numérique des écoulements, je peux tirer parti au quotidien de la formation reçue, tant sur la physique de l'écoulement, que sur l'aspect numérique.

### Which are your career plans ?

I have just started an internship and do not expect to be in the job market before 2021.

À l'issue de mon stage de fin d'études, et malgré le contexte de crise actuel, j'espère pouvoir faire jouer cet atout de taille dans mon cursus et profiter d'opportunités dans le domaine de la mécanique des fluides.





SPACE

## MS SPAPS

# Space Applications and Services

WITH AIRBUS DEFENCE & SPACE



## ■ Objectives

The first objective of this program is to give students a broad understanding of space systems and their environment, constraints and capacities in the fields of earth observation, communications and navigation.

The second objective of the program is to help students, using real-life examples and experimental work, to grasp the value of space systems for the creation of space applications and services. Students will propose and design tools and solutions in areas such as the environment, agriculture, transport or urban planning. They will be able to specify a complete telecommunications system according to user needs: Internet access, Internet of Things, fixed or mobile terminals ...

Students will be able to both better understand the performance of space systems and identify user needs, as well as develop new services and applications. The know-how in the digital domain have a central place in the training with topics like big data, cloud computing, digital communications, software radio.

## ■ Organization

### Head of program

- Prof. Raphaël Garcia  
Raphael.Garcia@isae-supaeo.fr

### Course duration

One year full time : 6 months of courses and 6 months of professional thesis or internship.

### Course start date

End of September

### Location

ISAE-SUPAERO Toulouse

### Teaching language

English

## ■ Syllabus

### Part 1: Space systems - 43 h

Space systems introduction

### Part 2: Digital techniques - 59 h

Big data and cloud - Digital communication and networking basics

### Part 3: Earth observation - 100 h

Remote sensing and sensors - Image processing and data analysis - Earth observation applications and services

### Part 4: Navigation and positioning - 22 h

Navigation and positioning

### Part 5: Space Communications - 111 h

Telecommunications and networks - Broadband satellite communication systems - Satellite broadcasting - Telecommunication satellites for mobiles - Satellite communication business

### Part 6: Space economics , regulations & services - 46 h

Space economics and regulations - Services and integrated applications

### Part 7: Tutored project - 80h

## ■ Learning approach

**First semester:** 6 months of courses delivered in Toulouse, mainly at ISAE-SUPAERO

**Second semester:** mission to be completed in a laboratory, an SME, in large companies.

### Company internship, professional thesis:

Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO.

The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

Overseen by an academic advisor and in-company tutor, the project entails the acquisition and development of knowledge and skills within a professional framework.

The subject, which must be approved by the academic advisor and the Director of the Advanced Masters programs, must:

- Give the student the opportunity to prepare for professional activities targeted by the program,
- Be a genuine issue of concern to experts working in the field.
- Must be related to the needs of companies in activity sectors covered by the program.

Students who have already acquired professional experience prior to the program, may complete their project in a research center or laboratory.

## ■ Career opportunities

This Advanced Master degree offers career opportunities in a wide range of fields:

Jobs related to cross disciplinary use of space data (observation of the earth and its atmosphere, telecommunications, data positioning, data from scientific missions and exploration) in complex information systems,

Consulting jobs to identify and define requirements, and implement application solutions using space data,

New jobs related to new space challenges.

The Advanced Master «Space Applications and Services» guarantees a high level of expertise required for today's and tomorrow's international space-related jobs.

Program graduates go on to work as Project Leaders, Business Engineers, Business Development Managers, Consulting Managers, Research Engineers, Expert in Space Applications.

### Companies recruiting our students

Thales Alenia Space, Airbus, CNES, SES ASTRA, AKKA Technologies





## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS ? What were your objectives ?

**JULIE AUTULY**

Graduated in 2018  
Digital Transformation Office Oceania - Airbus

I choose ISAE because it is a well-known engineering school around the world and the MS SPAPS offered both a general space education and an openness to the world and its current challenges, through space applications.

**ROMAIN BOULAIS SINOU**

Graduated in 2019

I decided to apply for the SSpace Applications and Services Advanced Master – SPAPS, because of its tight links with companies (and mainly with Airbus). Moreover, in a reconversion context, my main objectives were to integrate a training within which practice was prevailing and which would increase my employability in the space field.

### According to your experience, which are the strong assets of the Master ?

The strong assets are its close connexion to industry, the teaching quality and the enthusiasm its subject drives.

The strong assets of this training are not only its tight links with companies, as mentioned above, but also the diversity of modules offered: remote sensing, signal treatment, image processing, machine learning, telecommunications and broadcasting. I have been provided with a wide knowledge being confronted with main space applications issues. This was a unique opportunity to use these new skills in the appropriate context.

### Which are your career plans ?

I will be finishing my one-year contract at ESA by the end of October. Nothing is settled yet, but I might go on with a VIE, still in the aerospace sector.

I plan to become an IMINT (IMagery INTElligence) or GEOINT (GEOspatial INTElligence) engineer.





SPACE

# MS TAS ASTRO

## Space systems engineering

OPTIONAL PATHWAY «SPACE EXPLORATION»

(SEEDS)



### ■ Objectives

The TAS Astro - Space Systems Engineering Advanced Master program is a one-year professional course of study. The TAS Astro Advanced Master allows students to develop a high level of multidisciplinary skills in space science, space systems engineering and space project management. It enables the students to access work opportunities with numerous career opening in aerospace projects, be it with space agencies, research agencies, or industrial companies in an international environment.

The program is designed for students who wish to start immediately after the completion of their graduate degree and for employees who have enrolled through their companies continuing education programs.

The TAS Astro curriculum includes a broad spectrum of subjects with the following objectives:

- to develop specific skills applied to space sector :  
Space systems engineering and management of space projects
- to acquire high interdisciplinary knowledge related to technical aspects, economic and legal concerns of space projects.
- to acquire high interdisciplinary knowledge related to technical, legal and economic aspects of international space programs

### ■ Learning approach

**First semester:** academic session of 560h, provided by ISAE-SUPAERO's permanent professors and various experts from research centers (ONERA), space agencies (CNES, ESA), or European aerospace companies (Thales Alenia Space, Airbus Defense & Space, ArianeGroup).

This first semester includes:

- lectures and exercises,
- engineering and design study seminars,
- laboratory sessions,
- written reports and oral presentations,
- practical sessions, team work and industrial visits.

**Second semester :** students have to conduct a professional thesis or perform an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

### ■ Organization

#### Head of program

- Prof. Stéphanie LIZY-DESTREZ  
stephanie.lizy-destrez@isae-supaeero.fr

#### Course duration

One year full time : 6 months of courses and 6 months of professional thesis or internship.

#### Course start date

September

#### Location

ISAE-SUPAERO

#### Teaching language

English



SEEDS

### Space Exploration and Development Systems

The SEEDS (Space Exploration and Development Systems) international placement is an optional extra project. The student will work in multidisciplinary teams on space exploration research projects, designed in collaboration with advisors from the space industry.

ISAE-SUPAERO's partners in SEEDS are the Politecnico di Torino in Italy and the University of Leicester in UK. All three institutions have strong links with the space industry, a heritage of space research and exploration, and high-level expertise in the delivery of teaching. The student will spend two months at each institution and will be required to cover basic travel and subsistence costs. The course is taught in English at all three sites.

The international SEEDS program is supported and endorsed by the Italian (ASI), French (CNES) and UK Space Agencies, as well as Thales Alenia Space, ALTEC and numerous other companies and institutions, ESA (European Space Agency).

## ■ Syllabus

### Part 1: Missions and Systems 155 h

Mission analysis and orbital mechanics – Space environment & effects – Space systems architecture: Ground segments, satellites & sub-orbital planes – Launchers architecture

Space communication systems – Satellite based localization systems – GNS ( Global Navigation Satellite System) – Human Spaceflight: History of space exploration, medical aspects & human factors

### Part 2: Space Programs 160 h

Introduction to quality processes – Space programs bid for tender – Space programs & projects – Systems engineering of space programs – Systems dependability – Integrated team project – Financial & legal aspects: debris situation, new space (nanosatellites & launchers) – Spacecraft operations

### Part 3: Sub-systems: Satellites & Launchers 190 h

Advanced control & applications -Estimation and filtering - Satellite AOC (Attitude & Orbit Control System) – Launchers guidance and control -Real time control of a space system- On board data handling sub-systems: functions and architecture-satellite electrical systems – satellite thermal control systems- satellite propulsion: chemical & electrical – Mechanical architecture: Space structures & mechanisms

## ■ Career opportunities

TAS Astro Advanced Master program leads students to technical employment either in international industries or in research centers in aerospace world.

Current positions are: Space program project managers, Space Systems engineers, Experts in industry or public research laboratories, in Consulting or services companies.

### Companies recruiting our students

Altran, Airbus Defense & Space, Aéroconseil, Astek, Atos Origin, Bertin, Eutelsat, Eurilogic, Safran, Sopra Group, Thales Alenia Space, CNES, ESA, DLR (Germany), Instituto Mexicano de Comunicaciones (Mexico). GTD International (Spain), etc...



## Testimonies

Why did you choose ISAE-SUPAERO and apply for this master?  
What were your objectives?

### PAULINE DELANDE

Graduated in 2019  
Operations Engineer - CNES

I would like to emphasize the quality of the theoretical and practical courses provided by numerous passionate industrial experts, researchers and ISAE-SUPAERO teachers.

The Master is well organized, turned towards an industrial application: it allows students to build a first network for future internships and jobs. The topics covered are complementary and provide strong knowledge.

This knowledge is then applied through very interesting projects. To cite two examples: we worked per groups on the design of a Human permanent outpost on Phobos for up to 12 astronauts and on the development of a space transportation solution from Low Earth Orbit to Geostationary Orbit for commercial satellites (SpaceTug).

At last, I also took the SEEDS option where I worked for 6 months with 38 other European students on a manned mission on the Moon to produce propellant by exploiting Lunar In-Situ Resources as a System Engineer and Project Manager. In addition to keep learning, this project allowed us to travel a lot in Europe and forge amazing memories.

## What are your career plans ?

Now that my internship at CNES (French Space Agency) is over, I would love to work as a System Engineer on space projects in relation with Advanced Concepts, Space Exploration or Human

Spaceflight missions. My dream is to work for a Space Agency and/or launch my own company one day.





# MS SEN

## Systems Engineering



### ■ Objectives

Systems Engineering is an interdisciplinary discipline of engineering combining all sciences and technologies into integrated team from design, to development, up to operations and disposal of competitive and complex systems.

Systems Engineering approach is the capacity to federate and control various, interweaving and complementary engineering activities. This approach goal is to deliver satisfying systems, on-time, within expected budget, with the level of quality and performances meeting requirements of an open and competitive market. Systems Engineering process implements technical processes (requirement engineering, design, integration, verification, validation, etc.) as well as project management processes, agreement processes and enterprise processes.

The Systems Engineering Master degree program is a one-year professional course of study, designed in partnership with the industry. This program aims at providing worldwide industry with skilled professionals in Systems Engineering able to specify, design, deploy and maintain competitive and complex systems, fit to purpose, in various industrial sectors: space, aeronautics, air traffic control, land transport systems, maritime transport, health industry, energy, communication systems, etc.

### ■ Organization

#### Head of program

- Prof. Jean-Charles CHAUDEMAR  
jean-charles.chaudemar@isae-superaero.fr

#### Course duration

One year full time : 6 months of courses and 6 months of professional thesis or internship.

#### Course start date

September

#### Location

ISAE-SUPAERO

#### Teaching language

English

### ■ Learning approach

First semester: academic session of around 500 h, provided by ISAE-SUPAERO's permanent professors and experts from industry bringing current knowledge and experience, including: lectures, tutorials, industrial study cases. And 45h devoted to the coaching of the Integrated Team Project run all along the semester.

Second semester: Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

### ■ Syllabus

#### Teaching part (First semester)

##### Part 1: Outlines, topics and Fundamentals - 41h

Systems Engineering Introduction, Introduction to Space Systems, Project Management Introduction, Introduction to verification & validation,

##### Part 2: Roles : processes and Specialities - 167 h

Requirements engineering, Systems modelling and Analysis, Systems design and architecture, Integrated Logistic Support, Project Technical Management

##### Part 3: Deployment, methods & tools - 165 h

Systems Engineering Data Technical Management, «Optimise, decide, justify, & Validate», Systems Dependability, Systems performance Assessment & Management

##### Part 4: Industrial applications, study cases - 97 h

- Airbus : Systems Engineering & Certification of the A350
- Dassault : Systems Engineering at Dassault Aviation
- DGA : System of systems (systems engineering methods and tools, introduction to space system)

##### Part 5: Integrated Team Project (ITP) - 45h

### ■ Career opportunities

Systems Engineering is now a real and permanent concern for any business players, from Major Governmental contractors, to equipment manufacturers, to prime contractor integrating systems, and services companies such as Airlines for instance.

Systems Engineering jobs are characterized by many disciplines:

- multidisciplinary - mechanics, electronics, information technology, etc,
- strong interface with project management,
- permanent concerns all along the life cycle of a system. Need of Systems Architects is increasing for both industries developing, producing and maintaining large complex systems (aircraft, ships, military and defence systems, cars, etc.) and other industries developing and producing smaller high technology products (cameras, mobile phones, printers, computers, etc.). This Master program offers students great opportunity to join Engineering Team Systems within industries in different economic sectors.

#### Companies recruiting our students

Safran, CAST, Luxembourg Space Telecommunication, Dassault Aviation, Airbus Group and its subsidiaries, EGIS Avia, Arianespace, ALTEN, AKKA, Seditec, Safran Transmission Systems, Thales Alenia Space, INPE (Brazil), AVIC (China), COMAC (China), Thales China, Geo-Informatics and Space Technology Development Agency (Thailand).

INCOSE

#### INCOSE certification in ISAE-SUPAERO

At the end of the first semester, all SEN students are encouraged to participate in a one-month complementary program in preparation for ASEP\* level of INCOSE (International Council on System Engineering) certification. INCOSE certification consists of an exam which has an international-recognized value to validate knowledge and skills in systems engineering.





## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS ? What were your objectives ?

#### **GEOFFROY LE COURTOIS DU MANOIR**

Staff Research Engineer - Caltech  
Graduated in 2020

 I graduated in 2007 and have been part of Thales since 2015. Before starting the training program, I was working as a systems engineer for airborne equipments. My activities were related with maintenance and customer support services. I was in charge of developing and validating solutions in accordance with the stakeholders' needs. I liked my job very much because of the autonomy I had, driving experts and suppliers from a set of needs towards one solution. However, as I am passionate about aerospace, and since my job was focused on ground support equipments, such as transportation

cases, hand maintenance tools and test benches, I felt a discrepancy between my work and the field I like. Also, despite having learnt Systems engineering online with MOOCs and by the practice, I pinpointed the need for a real and in-depth training :

- \*to get a big picture of the activities involved in the V-cycle,
- \*to grab the appropriate methods and tools,
- \*and to understand the challenges to come.

I chose to apply to the Systems Engineering Advanced Masters program at ISAE-Supaéro to further excel in my job, to get hands on aerospace systems engineering projects and to get the chance to go working abroad.

### According to your experience, what are the strong assets of the Master ?

Teachers are mostly coming from industry and are working on aerospace systems engineering projects. The messages delivered are consistent with the skills, methods and tools the aerospace industry is currently looking for. Some researchers also take part in the teaching team. Being passionate people, they bring more theoretical knowledge with expertise on specific matters. They open doors to future interesting challenges.

\*ISAE-SUPAERO is the reference engineering degree school in France and Europe about aerospace training. ISAE is also very well known in companies and provides strong assets when negotiating a job offer.

\*ISAE-SUPAERO owns an alumni network with 25K former engineers, settled in most well-known companies, on the edge leading technology. Teachers and professional classmates are also a great way to expand one's network and plan a professional career.





# Embedded Systems

(ISAE-SUPAERO / INP-ENSEEIH)



## Objectives

Embedded Systems are an essential part of almost every aspect of our daily lives from transportation (aeronautics, space, road, rail and sea) to energy and taking into account communication systems.

As part of the AeroSpace Valley project, Toulouse has become a key centre in the design of advanced critical embedded systems. Toulouse has one of the highest concentrations of Embedded System industries in Europe with leading aerospace and equipment manufacturers working for the aeronautical, space or car industries, including the Airbus Group and its subsidiaries, CNES, Continental and Thales.

The Embedded Systems Advanced Master Program provides comprehensive training for engineers willing to be a part of the aerospace industry. This Embedded Systems Master Program is a one-year professional course, designed by INP-ENSEEIH and ISAE-SUPAERO partners with the support of the embedded systems industry to prepare students for challenging aerospace projects.

This program focuses on a multidisciplinary approach and prepares students by passing on in-depth and comprehensive knowledge of the technologies underpinning embedded systems with an emphasis on aerospace. The program focuses on both theoretical and concrete aspects and aims at:

- Developing Embedded-Systems engineering design skills at both system level and function level, built on a solid foundation of complementary subjects: electronics, computer science, energy conversion and management, automatic control, telecommunications and networks;
- Developing a system approach through integrated projects to master specific methods and tools as applied to the following domains: aeronautics, space and the automotive industries. The curriculum is multidisciplinary. It covers hardware (electronics, energy), software (computer science, network links, modeling, analysis and certification) and such issues as Embedded Systems control from an integrated system perspective.

## Organization

### Head of program

- Prof. Janette CARDOSO  
Janette.cardoso@isae-supaero.fr
- Prof. Jean-Luc SCHARBARG  
jean-luc.scharbarg@enseeiht.fr

### Course duration

One year full time : 6 months of courses and 6 months of professional thesis or internship.

### Course start date

September

### Location

ISAE-SUPAERO and INP-ENSEEIH

### Teaching language

English

## Learning approach

### First semester:

An academic session of 546 hours of teaching, provided by the tenured professors at ISAE-SUPAERO and INP-ENSEEIH and industry experts with their up to the minute knowledge and experience. Teaching activities include lectures, tutorials, lab work and a one-month multidisciplinary project aimed at integrating the academic session into an industrial case study.

### Second semester:

Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from INP-ENSEEIH or from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

## Syllabus

Embedded Systems require a collaborative training approach across a broad spectrum of knowledge involving experts from all fields concerned: electronics, energy, science, networks and control systems.

Hence, the academic part of the Master program consists of a 520 hour long program covering all five disciplinary fields that focuses on architectural aspects through a set of application-oriented lectures and seminars.

### Part 1: Embedded Systems - Core - 180 h

Real-time languages - DES Design and Validation - Feedback control - Signal processing - Microprocessor and DSP architecture - Architecture, design and Synthesis of hardware systems - RF Front-end Architecture - Electromagnetic compatibility

### Part 2: Energy - 63 h

Actuator and converter control - Electromechanical and static energy converters - Autonomous energetic systems - Embedded electrical networks

### Part 3: Networks - 67 h

Embedded networks: an introduction - Specific buses and networks - Real time networks - Design and validation of real-time protocols - Architecture of fault-tolerant buses - Scaling an avionics network.

### Part 4: Embedded Systems Design - 160 h

Real time control of an space system - Hybrid Systems - Model-Based System Engineering and Architecture - Real time control of a mechatronic system - System Dependability - Certification - Embedded systems and IT Security - Optimization

### Part 5: Embedded Systems Applications - 50 h

Aircraft technics - Introduction to Space Systems - Automobile technics - Workshops



## ■ Career opportunities

Embedded Systems offer challenging career opportunities. The course is designed for both young graduates and experienced engineers seeking a postgraduate program to enhance their technical and managerial skills. The skills acquired in this Master's course can be applied to any industrial sector in which embedded systems are used: aeronautics, space, road, rail and sea, energy industry, communication systems, etc.

Career opportunities in this area are numerous and on the increase in large and small companies alike. This Embedded Systems Master's course qualifies students for employment as designers, developers, research engineers and project managers in the design and development of innovative embedded systems.

### Companies recruiting our students

Accenture, Airbus Group, Altran, Astek, Atos Origin, CS Communications & Systèmes, NAVAL GROUP, CONTINENTAL, MBDA, Motorola, Realix, Safran, Sogeti High Tech, Sopra Group, ESA, GE HEALTHCARE TECHNOLOGIES, Philips R&D (Netherlands), Thales Alenia Space, SIGFOX, ...



INCOSE

### INCOSE certification in ISAE-SUPAERO

At the end of the first semester, all EMS students are encouraged to participate in a one-month complementary program in preparation for the ASEP\* level of INCOSE (International Council on System Engineering) certification. INCOSE certification consists of an exam which has internationally recognized value to validate knowledge and skills in systems engineering.

\*Associate Systems Engineering Professional



## Testimonies

### Why did you choose ISAE-SUPAERO and apply for our master? What were your objectives?

#### SHIN YESL

Embedded Systems Engineer - UBLU Digital Services  
Graduated in 2019

☹️☹️ Wanted to change my carrier path to aeronautics and before starting the new path I'd like to study a bit more on the subject to specialise my knowledge.

#### ELIOT GENTET

Graduated in 2019

☹️☹️ After graduating from a General Engineering school, I was looking for a training course that could give me more knowledge in electronics. After some research, I found that the MS EMS that offer ISAE-SUPAERO was the perfect fit for me. It offers technical courses on embedded systems, but also courses that provide a holistic view on the embedded system sector. My two main objective was to gain practical knowledge, and to increase my professional network.

### According to your experience, what are the strong assets of the Advanced Master?

You can cover the overall knowledges on the specific theme depending on the major. Most importantly you can meet and experience many classes and people(professors) from the current business field. So it is really practical and unique experience you can get from the MS program.

One of the strong assets of the MS is the system engineering module. This module provides tools for the overall conception of an embedded system, it helps understanding the big picture of the system.

### What are your career plans?

I recently joined to one embedded engineering company. I will keep trying to participate on aeronautics projects so I can make my dream goal comes true to become an aeronautical engineer.

Throw the internship I confirmed my interest in FPGAs, so my career plans are to continue working with FPGA in the space sector.



DIGITAL

## NEW - MS AIBT

# Artificial Intelligence & Business Transformation



WITH IRT SAINT-EXUPÉRY

### ■ Objectives

A manager in charge of the transformations needed to monetize data, notably using AI, is commonly known as a “Data Evangelist”. This Advanced Master targets a new profession through part-time training for high-potential technical specialists and managers (from scientific disciplines) with several years of work experience. Upon completion, students will be equipped with a solid culture in AI (along with the related big data) and will be able to work on the operational, intermediate or strategic level to manage projects where these new technologies play a role and teams in related new professions, such as big data engineers, data analysts, data miners and data scientists.

### ■ Learning approach

The program comprises 3 blocks:

**168-hours teaching block** for upgrading technical skills in AI, covering bulk data management and machine learning from a theoretical point of view (understanding solutions and large families of algorithms) and from a practical point of view (manipulations on simple examples, assessment of complexity and limits).

**119-hour teaching block** on business transformation by and for AI, covering the current impact of AI on various sectors, the implementation of a data value strategy and managing change in an AI context.

**72-hour block** of practical work to obtain high-level skills in business transformation through AI, with long-term examples covering all aspects of the training, whether strategic and tactical aspects from a business point of view, or a technical approach to move from data acquisition to a valuable product..

Five principles will be followed in all courses to adapt them to the students in training:

- Connections between the techniques and business;
- Developing concrete use cases;
- Discovering a variety of fields of application;
- Interactive teaching;
- Knowledge acquired is applied to a project on a common theme.

### ■ Organization

#### Head of the program

- Prof. Carlos AGUILAR-MELCHOR  
carlos.aguilar-melchor@isae-superaero.fr

#### Course duration

One week a month for 10 months

#### Course start date

Please contact us

#### Location

ISAE-SUPAERO (Toulouse)

#### Teaching language

English

This Advanced Master is organized in a partnership with IRT Saint Exupéry. IRT Saint Exupéry is the product of a public/private partnership co-financed by companies in the aeronautics, space and automobile sectors and the French State through its Programme d'Investissement d'Avenir (PIA - Investment Program for the Future).

Since its creation in 2013, an increasing share of its research programs have been enriched with contributions from “modern” artificial intelligence, in other words based on statistical machine learning, for applications in on-board aerospace and automobile systems.

### ■ Syllabus

The associated program will comprise a core curriculum for all students, organized into 3 blocks:

#### Part 1: Artificial Intelligence Internals - 168 h

Data Integration and Exploration, Big Data Processing, Optimization Topics for AI, Machine Learning and Data Analytics, Sequential Decision Making in AI, AI certification, Robustness and Dependability.

#### Part 2: Business Aspects of Artificial Intelligence - 119 h

Introduction to Modern AI, The Business of Data, Data Value Creation, Change Management.

#### Part 3: Practical skills - 72 h

Hands-on practice

#### Professional Thesis:

Students will do personal work for a period of 4 to 6 months, leading to the individual defense of a professional thesis.

This thesis may be prepared at the student's company or during an internship, notably at IRT Saint Exupéry, for students who do not have an employer at the time of the course.

The subject of the professional thesis will be sought out and chosen by each student with support from ISAE-SUPAERO, validation by the Professor/Academic Advisor and approval by the Director of the Advanced Master programs.

### ■ Career prospects

This program is organized with support from such major corporations as AIRBUS, AIRBUS HELICOPTERS, APSYS, COLLINS AEROSPACE, CONTINENTAL, DASSAULT AVIATION, ESI Group, STELIA, THALES ALENIA SPACE and CERFACS.







## PROJECT MANAGEMENT

# MS APM

## Aerospace - Project Management

(ISAE-SUPAERO / ÉCOLE DE L'AIR / ENAC)



### ■ Objectives

Aeronautical, Space and Defense business is, by nature, complex, innovative with high technical added value. Placed at the heart of political, economic, environmental and technological issues, in France, in Europe and worldwide, it requires a prospective vision from decision makers. It is based on specific industrial processes, characterized by long, costly and risky cycles (R & D, production, maintenance & support).

In this context, project management in aerospace environment requires mastering a wide scope of knowledge, know-how and expertise adapted to the specific needs and issues of this challenging worldwide business.

To answer to these concerns, ISAE-SUPAERO, Ecole de l'Air and ENAC gather their expertises to develop the Aerospace Project Management (APM) advanced master.

The professionally-oriented APM advanced master provides students with an overview on military or civil international Aerospace industry and gives up-to-date skills, cutting-edge knowledge, and necessary competences for successfully leading Project or Program teams in global aerospace and defence industry.

### ■ Learning approach

First semester: with an emphasis on operations, the program is designed to those beginning their career in management of projects or to professionals aiming at enhancing their competences for a fast career evolution. The program of the APM is taught, by experts or lecturers with extensive aerospace project experience, with a combination of formal presentations, in-class exercises and study cases. The objectives of this practical approach are to provide students with current techniques and tools in project management taking into account industrial, economical or legal specificities of the Aerospace business.

The teaching staff is composed of professors, lecturers and consultants from ISAE-SUPAERO and Ecole de l'Air (CReA). Several consultants, experts into project management are invited to deliver their knowledge from their own experience.

On top of that, many experts from industries, most of the time heads of aerospace programs, will illustrate parts of the courses.

Second semester: students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from Ecole de l'Air or from ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

### ■ Organization

#### Head of Program ISAE-SUPAERO

- Prof Philippe GIRARD  
philippe.girard@isae-supaero.fr

#### Head of Program Ecole de l'air

- Prof Pierre BARBAROUX  
pierre.barbaroux@ecole-air.fr

#### Head of program ENAC

- Prof Nicolas PETEILH  
nicolas.peteilh@enac.fr

#### Course duration

One year in full time : 6 months of courses and 6 months of professional thesis or internship

#### Course start date

End of September

#### Location

- ISAE-SUPAERO (Toulouse)
- ENAC (Toulouse)
- École de l'Air (5 weeks in Salon de Provence - October November)

#### Teaching language

English

### ■ Syllabus

The comprehensive training program is organized into four teaching parts:

#### Part 1: Overall overview of aerospace industry - 50 h

The first part provides the students with an in-depth overview of worldwide aeronautics and space industries enabling them to have an overall understanding of technologies, products, innovation and strategy stakes in the global civil and defence market.

#### Part 2: Methodology - 190 h

This part leads to a good understanding of Project management tools (WBS, planning, needs specification, etc).

Models and Methods of Project management for Aerospace context with specificities for high stakes and long cycle programs.

#### Part 3: Economic and financial aspects - 150 h

This part leads to a good understanding of economical stakes for nations or industries and the role of politics.

How to evaluate the cost of a long term program, the investment return hope, but also how to manage costs during development or manufacturing phase.

#### Part 4: knowledge management in multicultural team project - 60 h

This part underlines the necessity to integrate and federate competences around a common objective: how to motivate people for a long term project.

How to integrate intercultural management within international Program to avoid conflicts and change resistance.

In each of these parts the risks evaluation and control will be systematically underscored as well as Quality concepts and indicators dedicated to Aerospace context.



## ■ Career opportunities

APM advanced master program leads students to integrate or to become Head of Aerospace program team. To conceive and pilot complex projects with permanent care of costs and risks control in Aerospace companies or in defense in

### Companies recruiting our students:

AIRBUS, Air France, AVIC, Liebherr Aerospace, Reliance Defence, Scalian, Safran Electronics & Defense, Elron Consulting, Jet Aviation, RUAG Aerospace Structures....

### PMI

### PMI Certification

The APM program offers you to get PMI Certifications: CAPM or PMP. In an increasingly changing world, professional certification ensures that project managers to meet the demands of space projects through the globe. By offering an additional month of training, you will be specially prepared to CAPM or PMP exams. Volunteers will have opportunity to complete the APM diploma with a PMI certification well known and appreciated through the world and which open door to success. Teachers for preparation are certified themselves and experts of PMBOK reference.



## Testimonies

### Why did you choose ISAE-SUPAERO and apply for this MS ? What were your objectives ?

#### PAVITHRA MANGHAIPATHY

Graduated in 2019

At my masters program at Georgia Tech we had a presentation from ISAE-SUPAERO and even before that while I was researching Global Aerospace Programs I had come across ISAE several times. Having the chance to talk to my professors and also interact with the panel at the presentation solidified my decision to apply because I was looking for a global program. As for the APM Advanced Masters, I sat and thought about where I wanted to be in the Aerospace Industry, I had an American Degree which was very research focused but I wanted to gain a better understanding of the Global industry situation. In order to do so, the MS APM course at ISAE offered a package that was very broad and I felt as though I could benefit from the learning experience.

#### CAMILLE RIAN

Cohort 2019/2020

I am currently working as an Intern at Thales Land & Air Systems, as a Customer Training Marketing Officer.

After completing a Master in Management at IESEG School of Management, I was looking for an additional training in the aerospace industry, as I am passionate about aeronautics and I wanted to work in this industry. It seemed natural to me to apply to ISAE-SUPAERO in particular because of its reputation, and its very good ranking in higher education in the field of aerospace engineering. Also, the school's localization, in Toulouse, at the heart of the European Aerospace industry made my choice even more obvious. Therefore, on both academic and professional sides, I believed it was the best choice to fulfill my project. Then, two things made me choose this MS: the technical aspect of Project Management applied to the aerospace industry as a whole, and the fact that the program has some courses at ENAC and Ecole de l'Air.

My objectives were to acquire technical knowledge on Project Management, and to learn how a project is led in the aerospace industry. I also intended to acquire a better culture of both civil and defence markets. Finally, my objective was also to start building a network in this industry, as well as to meet and work with people who have a completely different background as mine.

### According to your experience, what are the strong assets of the Master ?

I think the strongest asset of the Masters is that it covers a lot of topics. While that may seem a bit daunting, it really offers the chance to see the industry for what it is and appreciate its vast diversity. The Aerospace Industry is very complex and is very unique in its own right, combine that with the turnover and rate of development, I think this master puts it all into perspective and helps you really plan out a path.

The biggest asset of the Advanced Master, for me, is that it is complete: it covers both civil and military cultures environments, and shows the wide diversity of the aerospace industry through different points of view, and by covering all the subjects of Project Management. The program helps to understand the Aerospace Industry as a whole, with its problematics and stakes. Also, this would not be possible without the quality of the professionals who come to teach the program. Experts in their field, with different professional and cultural backgrounds, they are key to help students understand Project Management in this very particular industry. Finally, the last important asset is the diversity of cultures and nationalities within the year group.

### What are your career plans ?

Currently, I want to invest all my energy into understanding how I can contribute to design and innovation now that I have both a technical and non-technical basis and reach a balanced approach. Even in the long term, I want to focus on streamlining innovation to be more open, inclusive and efficient.

Currently, I am half way of my internship at Thales Land & Air Systems, working in marketing. With the Covid-19 crisis, the industry has slowed down and recruitment is less frequent. It is important to keep having projects and to turn the situation as an opportunity. The defence environment has always been part of my former internships and professional experiences, and the Advanced Master has heightened my interest for it. I am working on how I can contribute to this environment, with the skills I learnt at IESEG School of Management and ISAE-SUPAERO, being both hard skills and soft skills.

**MS MGPIE****Management de Projets Innovants & Entrepreneuriat****■ Objectifs**

Le but de ce Mastère Spécialisé® est de développer simultanément l'esprit d'innovation et l'esprit entrepreneurial, tout en apprenant à manager des projets d'innovations technologiques, de « bout-en-bout » (de la génération d'idées à la mise sur le marché).

Ce programme s'inscrit dans la dynamique du développement de l'entrepreneuriat technologique dans lequel l'ISAE-SUPAERO est engagé, notamment avec la création d'un espace d'innovation (Innov'Space) et l'incubation de startups dans ses laboratoires.

Ces actions sont réalisées en relation étroite avec les grandes entreprises partenaires de l'école qui encouragent en parallèle le déploiement de nouvelles méthodes de management de leurs projets innovants dans un esprit d'intrapreneuriat.

Ce programme prépare plus particulièrement aux métiers suivants :

Métiers	Fonctions clés
Entrepreneur (Startuper)	Aller de l'idée à l'industrialisation jusqu'à la mise sur le marché d'un produit technologique innovant.
Chef de Projets Innovants (Intrapreneur)	Conduire des projets d'innovations technologiques au sein d'entreprises ou d'organisations avec des méthodes agiles et des approches telles qu'elles sont appliquées dans une start-up.
Responsable du Développement Technologique et de l'Innovation (CTO en charge de l'innovation technique et du déploiement de technologies)	Valoriser l'usage des nouvelles technologies comme levier de croissance au sein d'une entreprise, d'une start-up ou d'une organisation.

Des entreprises très variées soutiennent et participent à ce Mastère Spécialisé®, partageant toute la conviction de l'importance du développement pour les ingénieurs et les managers comme pour les entrepreneurs d'un esprit résolument ouvert à l'Innovation. Cette diversité permettra aux étudiants de bénéficier du dynamisme et de l'expérience de plusieurs secteurs industriels favorisant ainsi le transfert de bonnes pratiques.

**■ Méthode pédagogique**

**Le programme est constitué d'un tronc commun organisé en 4 blocs :**

- Bloc 1 : faire émerger des projets innovants - 85 h
- Bloc 2 : formaliser et structurer ce type de projets (y compris les soft skills) - 115h
- Bloc 3 : concrétiser et entreprendre - 115 h
- Bloc 4 : enseignements dirigés pour accompagner le Projet Innovant Exploratoire dans lequel tous les concepts vus en cours pourront s'intégrer et démontrer leurs plus-values - 36h

Les projets innovants exploratoires, qui se déroulent tout au long du 1er semestre, pourront être proposés par les étudiants eux-mêmes dès lors qu'ils seront porteurs d'un projet personnel, ou bien par l'ISAE-SUPAERO ou encore par des partenaires extérieurs.

Les étudiants seront invités à travailler en groupe dans cette expérience pédagogique. Tout au long de ce Projet Innovant Exploratoire, le corps enseignant de l'ISAE-SUPAERO offrira un accompagnement de type coaching pour suivre la maturation du projet et en particulier dans la phase de démonstration de sa faisabilité technique.

Les compétences des chercheurs de l'ISAE-SUPAERO et des acteurs de l'écosystème toulousain de l'innovation impliqués dans le programme, ainsi que les laboratoires de l'école seront accessibles aux groupes quand cela s'avérera nécessaire.

**■ Organisation de la formation****Chef de programme**

• Prof. Philippe GIRARD  
philippe.girard@isae-supaero.fr

**Durée**

Une année à temps plein : 6 mois de cours théorique et 6 mois de thèse professionnelle ou mission en entreprise.

**Retournée**

Octobre

**Lieu**

ISAE-SUPAERO (Toulouse)

**Langue d'enseignement**

Français

**■ Programme d'enseignement****Bloc 1 : faire émerger des projets innovants - des nouvelles technologies à l'idée créatrice****Portfolio des nouvelles technologies (39 heures) :**

Drones et véhicules autonomes, Propulsion, Matériaux avancés, Fabrication additive, Neuroergonomie & Facteurs humains, Traitement des données spatiales, Technologie web nouvelle génération, Machine Learning & Artificial Intelligence, Big Data, datascience, opendata : applications aéronautiques, Systèmes embarqués, Réseaux de communication, Données et services sécurisés, Blockchain, Cloud computing et services.

**Idéation & Exploration - 46 h**

Design thinking, Créativité, Veille technologique et concurrentielle.

**Bloc 2 : formaliser et structurer un projet innovant - de l'idée créatrice au projet****Management de projet - 49 h**

Conduite et gestion de projet – Généralités, Conduite et gestion de projet - Déploiement opérationnel, Boîte à outils du Chef de projet, Planification de projet, Méthodes Lean

**« Soft Skills » - 66 h**

Leadership, Communication, Négociation, Argumentation et Art de pitcher, Intelligence collective.

**Bloc 3 : concrétiser et entreprendre (méthodes et outils) - du projet à l'entreprise - 115 h**

Initiation à la logique comptable, Choix d'Investissement, Lean Startup, Étude de marché, Financement (levées de fond), Business model design, Propriété Intellectuelle, Aspects juridiques de la création et de la gestion d'entreprise, Marketing de l'innovation, Intrapreneuriat, Open Innovation, Méthodes Agiles et Scrum.

**Bloc 4 : Coaching entrepreneurial, digital et technique - 36 h**

**Thèse professionnelle :** d'une durée de quatre mois minimum, validée par une soutenance et un rapport, et effectuée dans le cadre d'une mission en entreprise (stage ou emploi) ou bien au sein de l'InnovSpace de l'ISAE-SUPAERO pour les porteurs de projet de création d'entreprise qui pourront ainsi bénéficier d'un support de l'école.

Cette formation se fait avec le soutien d'entreprises telles que : AIRBUS, DGA, ALTRAN, IoT VALLEY, Clinique Pasteur, CLS, COMAT, COVARIANS, NEOPTERA, PRAGMA Consult, des clubs d'entreprises innovantes : GALAXIE, GIPI, des start-ups : DIODON, DRONEAERO, FRISBEE, SPEERYT, U-SPACE.

**Testimonies****Why did you choose ISAE-SUPAERO and apply for this MS ?  
What were your objectives ?****CINDY SUESCA**

Cohort 2019/2020  
Internship at The MRO Lab - Innovation Lab.  
Air France Industries KLM.

As a mechatronics engineer, my objectives were to broaden my skills and acquire strong bases in Project Management. Isae - Supaero allowed me to approach these subjects while keeping a link with the technological context. In addition, the program show me the importance to consider and understand the different personalities in a team.

**ALEXANDRE LEMAITRE**

Cohort 2019/2020  
Consultant IT en financement de l'Innovation - FI Group

Je suis actuellement Consultant en financement de l'innovation chez Fi Group. Ce métier consiste à accompagner des entreprises innovantes dans la mise en œuvre des outils de financement les plus adaptés, et notamment celui du Crédit d'Impôt Recherche. En pratique, les missions débutent par un audit technique des projets de nos clients, puis j'identifie les leviers de financement adéquats. Ensuite, je réalise un dossier technico-économique pour justifier la demande, et enfin, j'accompagne les sociétés dans le cadre d'un éventuel contrôle fiscal.

**According to your experience, what are the strong assets of the Master ?**

The strongest assets of the MGPIE program is the great diversity of courses it offers. Its way to approach problems and real-life situations through several workshops led by professors as well as practitioners with different profiles. And a real implication of our Master director from the first contact time.

SUPAERO est reconnue comme une grande école d'ingénieur française avec un excellent rayonnement international. L'enseignement dispensé est de grande qualité grâce à l'intervention de professeurs experts dans leur domaine et de professionnels dotés d'une large expérience, exerçant dans les plus grandes entreprises.

J'ai souhaité candidater au MS MGPIE car à la suite d'un diplôme d'ingénieur en Génie Mécanique de l'UTC, je souhaitais me diriger vers des postes moins orientés vers la technique et d'avantage vers le management de projets innovants. La diversité des enseignements proposés m'avait également particulièrement séduit (Management de projet, Finance et comptabilité des entreprises, Marketing et stratégie d'entreprise, Négociation, Etude de marché, etc.). Enfin, ce MS bénéficiait de l'opportunité unique de mettre en pratique les connaissances et compétences acquises en menant un projet innovant en équipe durant toute la durée du cursus, pouvant par ailleurs aboutir sur la création d'une start-up.

**What are your career plans ?**

My career plans are to develop my knowledge and learn within large companies, with topics related to innovation management.

Dans un premier temps, je souhaite me perfectionner dans mon métier de consultant en financement de l'innovation avant d'évoluer potentiellement vers des postes alliant financement et management d'entreprises innovantes. Dans un second temps, après 5 ans d'activité, j'aimerais exercer un poste de management comme chef de projet ou manager d'équipe.



## MANUFACTURING

# MS AMPAS

## Advanced Manufacturing Processes for Aeronautical Structures

(ISAE-SUPAERO/IMT MINES ALBI-CARMAUX)



IMT Mines Albi-Carmaux  
Ecole Mines-Télécom

### ■ Objectives

The Aeronautical industry market is facing a rapid and continuous increase worldwide as shown by the record breaking contracts recently signed by both Airbus and Boeing. These two industry leaders forecast an increase of close to 5% in activity over the next years. Estimations indicate that the annual increase of large commercial airplanes will induce a doubling of the number of aircrafts by 2030. Nearly sixty percent of the turnover is subcontracted all over the world and concerns mostly production and manufacturing activities. As a consequence, most aeronautical subcontracting companies will have to increase their production rates but also to keep up to date with technological changes; moving from metallic processes toward composite materials processes. Moreover the aircraft manufacturers have changed their supply chain structure in the last years, and subcontractors are now required to manage more complex parts and to take over, on their own, the qualification processes.

The Advanced Master course AMPAS, is designed by IMT Mines Albi and ISAE with the support of aeronautical industry partners. It will give a specialization to master level students allowing them to take over high level responsibilities in airframe structure manufacturing plants. It is especially well suited to students who have followed general studies in mechanical engineering, material science or equivalent and who would like to gain a major chance to be recruited by aeronautical industry.

### ■ Organization

#### Head of program

- Prof. Jean-José ORTEU  
jean-jose.orteu@mines-albi.fr
- Prof Anis HOR  
anis.hor@isae-supaero.fr

#### Course duration

One year full time : 6 months of courses and 6 months of professional thesis or internship.

#### Course start date

September

#### Location

IMT Mines Albi - Carmaux, Campus Jarlard, (70% of classes)  
ISAE-SUPAERO, Toulouse (30% of classes)

#### Teaching language

English

### ■ Learning approach

#### First semester:

Academic term of 520h, provided by permanent professors of IMT Mines Albi and ISAE-SUPAERO and expert practitioners from aerospace industry to bring current knowledge and experience. The teaching, balancing academic lessons with more applied practice, includes:

- lectures and exercises
- process simulation sessions
- laboratory sessions
- practical sessions
- industrial conferences
- industrial and workshop visits
- multidisciplinary project of 100h
- written report and oral presentation

#### Second semester:

Students have to conduct a professional thesis or make an internship in an industry or in a laboratory, in France or abroad, supervised by a tutor from the host organization and from IMT Mines Albi or ISAE-SUPAERO. The thesis is concluded by the preparation of a report and an oral dissertation in front of a jury.

### ■ Syllabus

The academic course consists of modules aiming to provide a deep knowledge of the three main material families used in airframe structures (i.e. aluminum, titanium and long fiber reinforced polymer composites) and their related forming routes in aeronautical industries. It is also devoted to gain knowledge in aircraft architecture, on aeronautical supply chain specificities, lean manufacturing, quality management and certification requested to be able to take over technical and organisational responsibilities in industry.

A team project (100 hours) will demonstrate the ability to address an aeronautical part processing following the theoretical and professional skills.

#### Part 1: Aircraft, material and process basic scientific knowledge - 130 h

Flight Dynamics AMPAS - Aircraft and airframe architecture AMPAS - Computer Aided Design (CATIA) - Aluminium and titanium alloys - Epoxy and thermoplastic composites - Assembly processes - Material and processes qualification - NDT for metallic and composite materials - Optical techniques for assembly aid

#### Part 2: Composite structure forming and machining processes - 100 h

Physical phenomena description and modelling related to thermoset based manufacturing - Raw material and composite quality control - LCM/RTM processes - Autoclave Vacuum Bagging (monolithic - sandwich) processes - Composite material trimming, drilling and assembly - RTM/Infusion Simulation

### Part 3: Metallic structure forming and machining processes - 106 h

Material behaviour and mechanical models - Cold and hot sheet forming processes - Surface treatments - Subtractive and additive manufacturing - Sheet forming simulation

### Part 4: Industrial Organisation and management - 84 h

Supply chain structure and Organisation - Materials management and Lean manufacturing - Supply chain improvement and collaborative processes - Quality requirement, management and tools

### Part 5: Integrated Team Project - 100 h

## ■ Career opportunities

The Advanced Manufacturing Processes for Aeronautical Structures Master course offers challenging career opportunities for young engineers or more experienced engineers, who require a postgraduate program to enhance and/or focus their technical and management skills towards aeronautical industry sector.

Career opportunities are numerous and growing over the world, in tier 1 and tier 2 subcontracting companies, as well as in aircraft manufacturers, aeronautical maintenance companies. Graduated AMPAS students can find employments as process, industrialization, production, quality, research and innovation engineer, product, project and production manager...

### Companies recruiting our students

AIRBUS GROUP EFW (Dresde), AIRBUS OPERATIONS SAS, ALTEN, AKKA Engineering Process, ARMINES, AVIC COMAC, Fabrica Argentina de Aviones, FORMTECH (Breme), SAFRAN Power Unit, SAFRAN Helicopter Engines, VENG SA (Argentina), P3 GROUP, SAFRAN Aircraft Engineering, SAFRAN Electronics and Defense, SAFRAN Nacelles, DUQUEINE Atlantique.



## Testimonies

### Why did you choose this Advanced Master?

#### THÉO LE BOULAIRE

Cohort 2019/2020

Intern engineer in Manufacturing Engineering Methods - Airbus



I chose the AMPAS Advanced Master because, due to previous experiences, I knew that I wanted to work with manufacturing processes. I always have been passionate about aeronautics and the choice of this master became logic. In addition to that, the reputation of ISAE and IMT Mines-Albi for their relation with companies and the quality of their training were elements that strengthened my choice.

#### JULIETTE BERGE DOLET

Cohort 2019/2020

Intern - CRT Airbus



I chose the AMPAS master because I was looking for industrial and technical knowledge in the field of aeronautics with an international level. ISAE-SUPAERO is a very renowned institute in France, which certifies to obtain a quality education.

### According to your experience, which are the strong assets of the Master ?

The biggest quality of the AMPAS training is the professional-oriented mindset it has. A lot of teachers are people from Airbus, Safran and there are a lot of practical sessions that links the theory to the real world.

The strong assets of the AM, regarding my opinion, is the large number of courses given by industrial stakeholders, thus allowing to obtain a very technical and representative vision of the current industrial world.

### What are your career plans ?

I am planning to search for method or industrialization engineer positions.

My career plans are to work as technical support in the field of the of aeronautical repair.



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# EXECUTIVE EDUCATION

ADVANCED MASTERS,  
POST-GRADUATE DIPLOMAS (PGDIP),  
CERTIFICATES OF ADVANCED STUDIES (CAS)  
AND SHORT COURSES

ISAE-SUPAERO provides executive education programs for professionals who want to reinforce their skills in specific and technical domains such as :

- Aeronautics
- Digital
- Manufacturing
- Project Management
- Space
- Systems

## ADVANCED MASTERS **MS**

75 ECTS

Please refer to p 18 to 48.

## POST GRADUATE DIPLOMAS (PGDIP) **MS** **PGDip**

(1 semester - 45 ECTS) are dedicated to professionals who cannot take time off from their obligations for a one-year period. The following 9 Advanced Master courses are accessible in the form of 6-months post graduate diplomas:

- Space Systems Engineering (TAS ASTRO),
- Space Applications & Services (SPAPS),
- Aeronautical & Space Structures (AES),
- Aeronautical Engineering (TAS AERO),
- Helicopter, Aircraft & Drone architecture (HADA),
- Flight Test Engineering (TAS Aero-FTE),
- Aeronautical Maintenance & Support (AMS-E&M),
- System Engineering (SEN),
- Management de Projets Innovants et Entrepreneuriat (MGPIE).



# CERTIFICATES OF ADVANCED STUDIES



(from 44 to 102h)  
provide ECTS

16 Certificates of Advanced Studies which aim at developing new skills in a current or innovative area of expertise. They consist of a set of specific skills blocks of approximately 100 hours over 1 month.

## SHORT COURSES

(from 12h to 51h)

55 Short Courses are specialised training modules lasting a week as refresher or to explore a subject in greater depth.

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## Offered in the following topics



AERONAUTICS



DIGITAL



PROJECT  
MANAGEMENT



SPACE



SYSTEMS  
ENGINEERING

These shorter training courses meet the time constraints of executive and managers.

For companies who wish to make « bespoke » training available to their engineers, tailored to their needs, **EUROS<sup>AE</sup>**, a subsidiary of ISAE-SUPAERO, will respond to their request.

### Your contacts :

**Thibault BREMAUD** - Head of Executive Education & ECATA administrator

**Natalia PERTHUIS** - Executive Education Coordinator

**Catherine DUVAL** - Senior Admission Advisor

**Claire JUANEDA** - ECATA & Digital learning coordinator

**Info.exed@isae-supaeo.fr**



**ECATA:**

the European Consortium for Advanced  
Training in Aerospace.

# ADMISSION PROCEDURES

## ■ MASTER OF SCIENCE

### Academic requirements

Applicants must have a bachelor's degree or equivalent degree, in the following areas:

- Engineering: aeronautical, aerospace, mechanical, electrical, electronics, mechatronics, telecommunications, instrumentation, engineering science
- Science: physics, mathematics

Tuition fees and Funding : see our website

## ■ ADVANCED MASTERS

### Academic requirements

A master's degree, or an equivalent degree in science or engineering (or in management for advanced masters in management), or bachelor degree completed by 3 years of professional experience

Tuition fees : see our website

## ■ POSTGRADUATE DIPLOMAS

### Academic requirements

Same requirements as for Advanced Masters

## ■ CERTIFICATES OF ADVANCED STUDIES and SHORT COURSES

### Academic requirements

- English level equivalent to B2 - Common European Framework of Reference for Languages
- Technical and scientific background assessed case by case

## LANGUAGE REQUIREMENTS FOR ALL MASTERS

TOEFL (IBT)	or	TOEIC	or	IELTS	or	CAE/FCE
						
85 points (Inst. code: 9820)		785 points		6.5 points		170 points

## ■ SELECTION AND ADMISSION

**Selection and admission are made by an admission committee:**  
Possible interviews can be organized if necessary

### Deadlines for application:

Applications open in october 2020 for intake in september 2021.  
Several admission committees scheduled from January to July, see schedule on our website

### Application website :

<http://admissionsmasters.isae-supero.fr>



### Funding

Information on tuitions fees and funding can be found on our website

<https://www.isae-supero.fr/en/academics/advanced-masters/financing/>

## LANGUAGE REQUIREMENTS FOR MASTERS IN FRENCH

### Language qualification requested

Score B2-Common - European Framework of Reference for Languages

NOTA BENE : Volume of teaching hours and contents of the programs are provided for information only and are subject to change.



# Your contacts

**Philippe GALAUP,**

Head of recruitment and Contractual Relations  
Phone: +33 (5) 61 33 80 27

**Caroline ARMANGE**

Senior Admission Advisor / Advanced Masters  
Phone: + 33 (5) 61 33 80 25

**Catherine DUVAL**

Senior Admission Advisor / Aerospace sector  
Phone: +33 (5) 61 33 80 37

**Senior Admission Advisor / Masters programs**

Phone: +33 (5) 61 33 80 13





### Address

ISAE-SUPAERO  
10, avenue E. Belin  
BP 54032  
31055 Toulouse CEDEX 4  
France

### Contact

info-masters@isae-supaero.fr

### Website

www.isae-supaero.fr/en



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