

# Master of Science in Aerospace Mechanics and Avionics

## MSc AMA



### Aims

The Master of Science in aerospace mechanics and avionics is a two-year course of study that allows students to develop a high level of competence in engineering science, current technology, and engineering design related to aeronautics and space. It aims at preparing students for careers in the aerospace industry in Europe and worldwide. The program consists of a total of 4 semesters of 30 ECTS each, ie 120 ECTS credits for the whole program. The MSc AMA starts with a first semester emphasizing aerospace engineering and control to prepare students to the majors to be selected for semester two and three: «aerodynamics & fluid dynamics», «aeronautical structures» or «aircraft control». Five major are offered in semester 3 covering the main domains of aircraft and space vehicle domains. Students have strong opportunities to develop practical skills through research projects in ISAE's laboratories and professional thesis during internships in aerospace industry.

### Organization

#### Head of common program and global teaching coordination

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**Duration of studies:** Two year full time

**Beginning of classes:** September

**Location:** ISAE, Campus SUPAERO and campus ENSICA for some courses

**Teaching language:** English.

### Pedagogical approach

The ISAE Master's programs are designed with a combination of lectures, personal project and assignments and thesis projects to be performed in industrial environment or in ISAE's laboratories. They are taught in English.

Compliant with European higher education system, the MSc AMA is a two-year program with a total of 120 ECTS credits.

The MSc AMA program includes three-semester academic session, in ISAE's premises, provided by permanent professors and experts from aerospace industry bringing current knowledge and experience, including: lectures, tutorials, case study, personal project in laboratory and industrial visits.

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

### Syllabus

#### Semester 1

##### Common part - 105 h

Mathematics: Foreign languages - structures standardisation - Matlab standardisation

##### Aerospace and mechanical engineering - 233 h

Aircraft structures - Aerodynamics 1- Propulsion - Control & avionics - Computer Aid Design - Vibrations & modal analysis - Flight dynamics - Applied Aerodynamics - Modelling of Aerostructures (MEF)

# Master of Science in English

National Master Degree Accredited by the Ministry of Higher Education

## Semester 2: 30 credits

### Common part (320 h)

Foreign languages - European cultures and Research Project in ISAE's laboratories (250 h)

Students have to select one major among:

### Major 1: Design - aerodynamics & fluid dynamics - 120 h

Softwares for computational fluid dynamics – Acoustics – Flight characteristics – Experimental approach in fluid mechanics

### Major 2: Aircraft control - 119 h

Control implementation – Flight characteristics- Aircraft control - guidance – Navigation

### Major 3: Aeronautical structures -120 h

Materials for airframes – Calculating structures - Dimensioning structures – Design project

## Semester 3: 30 credits

### Common part - 150 h

Foreign languages – Research Project in ISAE's laboratories (100 h)

Students have to select one major among:

### Major 1: Advanced fluid dynamics - 197 h

Turbomachinery – Aeroelasticity – Turbomachinery 1: Advanced aerodynamics of turbomachines – Turbulence Aeroacoustics – Numerical fluid mechanics – Turbomachinery 2: The turbomachine system

### Major 2: Flight control - Guidance - 179 h

Multivariable systems – Optimal control – Estimation - Kalman filter – Control of flexible structures – Robust control - Space applications – Aircraft identification

### Major 3: Aeronautical structures - 223 h

Aircraft techniques – Helicopters – Flight dynamics - Propulsion – Quality – Dynamics of aeronautical and space structures – Advanced structural dynamics - Mechanics of laminated structures – Production and maintenance of aircraft

### Major 4: Aeronautical engineering - 233 h

Aircraft techniques - Helicopters - Flight dynamics - Propulsion - Advanced structural dynamics Aeronautical engineering environment - Mastery of aeronautical products - Aerodynamics - Materials for aerospace structures - Composites

### Major 5: Helicopter engineering - 261 h

Helicopter propulsion and motorization – Helicopter avionics – Arming - mission – Helicopter flights test- Certification – Helicopter maintenance – Aerodynamics - Flight qualities - Performances – Helicopter dynamics - Helicopter construction materials & techniques – Systems - Prototypes - tests-production quality assurance

## Semester 4

Students conduct a thesis in aeronautical industry or organisation, in France or abroad and supervised by a tutor from the host organisation and from ISAE. The Master thesis is concluded by the preparation of a report and an oral dissertation in front of jury.

## Career opportunities

Toulouse is at the hub of the European aerospace industry, and accommodates leading European engineering and postgraduate institutions.

The majority of graduates find positions in the aerospace industry (aircraft, engine and equipment manufacturers), and government agencies.

They have senior positions in industry as researchers, experts, and heads of projects or managers.

Several MSc AMA graduates are recruited for PhD studies at ISAE or other Universities.

### Companies recruiting our students

Accenture, ALTRAN, Aeroconseil, EADS Airbus, EADS Apsys, EADS Eurocopter, CNES, Sogeti High Tech, SAFRAN Snecma, EMBRAER (Brazil), Bombardier Aerospace (Canada) MECACHROME (Canada), Airbus China, AVIC (China) ASPECT RATIO ENGINEERING SERVICES GMBH (Germany), Eurocopter (Germany), MTU (Germany), SHELL (Netherlands), University Technology Malaysia, National Defense University Malaysia, ALENIA (Italy) SINGAPORE TECHNOLOGIES AEROSPACE (Singapore),...

### Industrial Partnerships

Airbus, wanting to motivate engineering Chinese students in the international orientation of their studies, awards international scholarships to a limited number of students applying to MSc AMA. Awarded students by Airbus take on a commitment to follow the study program Aeronautical structures specialisation.

# Masters of Science

## WITNESSES

### **HUAN Qianjiao, China, Graduated in 2010 - MSc AMA**

After I got my bachelor degree at BUAA (Beijing University of Aeronautics and Aerospace), I heard that there is an opportunity of the AIRBUS scholarship program to study the Master of Science in Aerospace Mechanics and Avionics at ISAE. As ISAE is the best European school for aeronautics, I'm very grateful for AIRBUS and ISAE gave me this opportunity to make my dream come true. During the two years at ISAE, we had classes not only in technologies but also in lots of other domains, such as management, language and culture. More than half of the classes are given by professors who are come from the industrial companies, AIRBUS, CNES, ONERA, EUROCOPTER, etc. We learnt the knowledge by a more professional way with helps a lot in our future career. The internship which took place at the last semester gives us a great opportunity to link what we have learnt at school to what we are going to do as a job in the future. For me, I have performed a six months internship at AIRBUS France which is a precious chance to me and leads me to my future career. After this internship, I was recruited by SOGETI High Tech which is a subcontractor of AIRBUS and I'm working now on some projects of structure calculation on the AIRBUS family aircrafts. More over, this two years mater is an international program with students coming from all over the word. Here, we got the chance to know the different cultures and ways of thinking in different countries and we made great friendship which we will never forget».

### **SUN Bin, China, Teacher at an aeronautic University, Graduated in 2011 - MSc AMA**

*Why did you choose ISAE and apply for our master ? What were your objectives ?*

I am a master student of MSc in Aerospace Engineering at ISAE, and I am specialized in Aeronautical Structures. Because I work at an aeronautic university in China, to be able to be a teacher I need to acquire a higher diploma and specifically in aeronautical structures, I choose to pursue the two-year engineering master degree in ISAE now.

*According to your experience, which are the strong assets of the Master you did ?*

First of all, I have learned a lot of associated courses about my future work such as structure mechanics, modeling analysis, CATIA, composite materials, acoustics and mechanics of laminated structures, calculation structures, landing gear, and so on. For the software part, I have obtained many experiences

from workshops with SAMCEF, Patran/Nastran, CATIA, MATLAB, and COMSOL. In addition, I have one year of research experience in Supaero participating in the study of the Effect of Heat Generation in a High Frequency Solicited Composite Beam, which combines the theory part I have learned and the practice. This research experience not only developed my professional knowledge but also enhanced my practical skills. Besides, I have finished my design project in ENSICA campus, which is about the center wing box conception project. I am in charge of the structure design in CATIA, detailed calculation of the loads and analysis of the fatigue life of the center wing box. I have learned a lot from this, and I know how to cooperate in team-work. And I think all of these mentioned above should be the strong assets of DNM AMA I have choosed.

*Which are your career plans ?*

To persue this master program is a crucial step in my future career. After the graduation, I will go back to China and try my best to be a good teacher in my university, and many thanks for ISAE to offer me profound knowledge and devoted attention.

### **Pau LATORRE - Spain, Graduated in 2011 - MSc AESS**

*Why did you choose ISAE and apply for our master ? What were your objectives ?*

I chose ISAE because of its reputation as I knew that Supaero and ENSICA where among the top aerospace colleges in Europe. Also Toulouse is the center of the the aerospace community in Europe and so I regarded it as positive for my career prospects if I wanted to orientate my professional future in this field. My objectives, as my previous education was in another field of engineering, were to provide myself with a high-level formal education in aeronautics. This way I could migrate from telecom engineering to aerospace engineering and pursue a career in aviation which is my biggest passion.

*According to your experience, which are the strong assets of the Masteryou did ?*

The stronger assets would be the strong ties to the aerospace industry in Toulouse, and the fact that many of the lecturers in the courses come from it. This means that you get to be taught by real-life engineers who are working in actual aerospace projects presently, and thus are not just devoted to academics as happens too often. Personally, I am specially attracted by the fact that many lecturers come from Airbus.

*Which are your career plans ?*

I wish to work for Airbus, if possible in flight test engineering.

# ISAE research - oriented - education principles

**ISAE master teaching is founded on research-education-interwoven policy in order to offer master's students to participate in a wide variety of research opportunities throughout their master course and beyond.**

ISAE is deeply committed in providing its students access to its research capabilities as well as its academic and industrial partnerships, covering the entire fields of aerospace engineering. From a research policy point of view, the double objective is to provide knowledge production as well as response to society and aerospace industrial needs. **ISAE main research partners are ONERA (the French Aerospace Lab.), LAAS-CNRS and OMP**, the largest French laboratories in the engineering sciences and space sciences fields, respectively. ISAE is involved into long-term research and development agreements with the main European aerospace companies: EADS (Astrium, Airbus, Eurocopter, IW), SAFRAN (Snecma, Turbomeca, Microturbo, Technofan), Thales Alenia Space, Rockwell-Collins, MBDA, Liebherr Aerospace. As a result of its commitment into aerospace higher education and research, ISAE is part of the management of the Aerospace Valley cluster (550 companies and education and research partners from Aquitaine and Midi-Pyrénées Regions).

**ISAE scientific activities are organized into 4 training and research departments and one aerospace center.**

- > The **department of aerodynamics**, energetics and propulsion (DAEP) develops its research activities on four axes:
  - > turbulence, instabilities and numerical simulation
  - > turbomachinery and propulsion
  - > advanced aerodynamics and flow control
  - > aerodynamics and propulsion of micro-air-vehicles.DAEP benefits from noteworthy experimental facilities as a **large wind-tunnel (with an elliptic 2 x 3 m wide test section)**, a low-Reynolds number quiet wind-tunnel, a double-flux turbojet engine mounted on a fully instrumented test-bank, a centrifugal compressor, and a turbocharger test-bank. The department also relies on local **computational means** and on the **largest French academic simulation facilities** to carry out numerical simulations with commercial and research codes.
- > The **department of mechanical** engineering, structures and materials is part of the **Clément Ader Institute** that gathers in a single laboratory all the research capabilities of the Midi-Pyrénées Region (UPS, INSA, ISAE, Mines Albi). ISAE professors' research is focused on
  - > damage to composite materials in aerospace structures
  - > fatigue of metal materials and structures
  - > dynamics of structures
  - > advanced numerical methods for mechanics.Again ISAE strongly supports this research by developing and sustaining large facilities like a drop tower (200 kg, 10 m/s), a rapid impact bench (500 g, 200 m/s), hydraulic fatigue machines, climatic chambers, modular frames for structure testing (wings... ) and analysis and control means (XRay spectrometer, nano-indenter, ultrasonic and radiographic non-destructive testing, scanning electron microscopy).
- > The **electronics, optronics and signal department** is organized into 4 research groups:
  - > microwaves and optronics for embedded systems
  - > **CMOS** imagers performance improvement and design (**CIMI Group**)
  - > signal, communication, antennas and navigation (**SCAN Group**)
  - > space instrumentation (**SSPA group**). The environment comprises a set of optical and optronic characterization benches, a **CMOS** imager design center, space telecommunication characterization and simulation benches. The **CIMI** group is involved into the **EADS Astrium – ISAE chair CRISTAL** with several world firsts in imager development for space applications. The **SCAN** group is part of the TeSA joint laboratory with Thalès Alenia Space, CNES and Rockwell Collins on Telecommunications for Space and Aeronautics. The SSPA team has developed a strong partnership with the 2 French largest space laboratories OMP and IPGP, and is the head of instrument development work packages in European and International projects in the frame of CNES, NASA and JAXA missions.
- > The **department of mathematics**, computer sciences and control develop methods, techniques and tools that make it possible to understand, analyze, evaluate, control and design the functional and operational behavior and performances of complex systems. The **MARS team** (modeling and architecture of systems) is structured around three axes:
  - > mathematical modeling and numerical simulation
  - > critical system engineering
  - > communication networks, this third axis being developed together with LAAS-CNRS and contributing to the TeSA joint laboratory. The **ADIS team** (control decision and interaction of systems) deals with
    - > automatics and flight dynamics
    - > autonomy and decision-making, including man-machine interfacing.Four platforms support this research: emulation and communication networks, cooperative robotics, parallel and distributed computing, and embedded system engineering.
- > Finally, the **aerospace center** (CAS) provides unique facilities such as a full flight simulator and a **fleet of 10 aircraft** dedicated to **training, research and Flight Test experiments**. This center is hosting the research on man-machine interfacing.

All four departments and CAS support a **Micro-aerial vehicle development** program at an international level, on the basis of student projects, research and innovation projects, and international competitions.

# Common ISAE's admission procedures

## Masters of Science

### Academic requirements

Applicants must have a bachelor's degree or equivalent degree, in the following areas: Bachelor in aerospace or mechatronics or mechanical engineering

### Tuition fees 2012-2014:

> 14000 € for the two-year master program

### European students:

> 8000€ (students graduated in the year of enrolment or the year before, and with no professional experience).

## Selection and admission

### Admission to ISAE's master at:

<http://AdmissionsMasters.isae.fr>

### Selection and admission are made by an admission committee:

> possible interviews can be organized if necessary

### Deadlines for application:

> several admission committees scheduled from March to July 2012, see schedule on our website: [www.isae.fr](http://www.isae.fr)

### Application fees:

> 65 € (non-refundable)

## Language qualification requested

- > TOEFL (Paper-based): 550,
- > TOEFL (IBT): 79,
- > TOEIC: 750,
- > IELTS: 6.0,
- > CAE Cambridge, ...

## Your contacts at ISAE

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# ISAE in few words

The "Institut Supérieur de l'Aéronautique et de l'Espace" (ISAE) was created in 2007 from the merger of the two prestigious French postgraduate schools of engineering, SUPAERO and ENSICA. Today, ISAE, is a world-class higher institute for aerospace engineering education and research. Nowadays with a student corpus of over 1500, ISAE is one of Europe's largest Aerospace Institute offering graduates and postgraduates programs. Yearly, ISAE awards around 20% of master's degrees in Europe in aeronautics and space field. ISAE develops its worldwide reputation on the prestige of its master's programs, the fame of its teaching staff, or the excellence of its research but also on the high-value of its graduates, their skills in engineering or management, as well, their capacity to evolve within a very high-technology environment, their enterprising mind and international opening.

## Key figures

- > 2 Graduate Engineering Programs: SUPAERO and ENSICA
- > 15 Specialized Masters including 11 in English
- > 3 Masters of Science
- > 6 Research Masters
- > 6 PhD Programs
- > 1500 students (1300 masters and 200 PhDs more or less)
- > 160 international cooperation opportunities
- > 50 academic and research partnerships

## Identity card

**Name:** Institut Supérieur de l'Aéronautique et de l'Espace (ISAE)

Founded in 2007 - as the result of the merging of SUPAERO (1909) and ENSICA (1945)

**Legal Status:** A large public institution of scientific, cultural and vocational missions

**Trustees:** Délégation Générale pour l'Armement (DGA) [French Defence Procurement] - Ministry of Defense

**Endorsements and awards:** CTI agreement of the two Graduate Programs, Conference des 'Grandes Écoles', for postgraduate specialized masters Ministry of Higher Education and Research for Masters of Science

**Staff:** 420 permanent staff



## Contacts ISAE

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