

# Embedded Systems

## (ISAE-SUPAERO, INP-ENSEEIH)

MS EMS

### Objectives

Embedded Systems are an essential aspect of our daily life, in all domains, from transport systems (aeronautics, space, road, rail and sea), to energy sectors and also to communication systems (e.g. smartphones).

As part of the AeroSpace Valley, Toulouse has established itself as a strong place for the design of advanced critical embedded systems. Toulouse has one of the greatest concentrations of Embedded Systems industry in Europe with the major aerospace and equipment manufacturers working either for the aeronautical, space or car industry, including Airbus Group and its subsidiaries, CNES, Continental, Thales.

The Embedded Systems Master Program has been defined to provide the industry with well-trained engineers willing to participate in this challenging environment. The Embedded Systems Master Program is a one-year professional course, designed by the INP-ENSEEIH and ISAE partners, with the support of the embedded systems industry to prepare students to challenging projects for the aerospace domain.

Aware of the real need for a multidisciplinary approach, the program prepares students with in-depth and comprehensive knowledge of the underlying technologies involved in embedded systems. The program focuses on both theoretical and concrete aspects. It aims at:

- developing competencies, both at system-level and function level design for the engineering of Embedded-Systems, based on strong basics of complementary subjects: electronics, computer science, energy conversion and management, automatic control, telecommunications and networks;
- developing the system approach through integrated projects to master specific methods and tools applied to the following domains: aeronautics, space and automobile.

The training for this Master's degree is multidisciplinary. It covers all hardware (electronics, energy), software (computer science, links with network, modeling, analysis and certification) and control issues of Embedded Systems within an integrated system based perspective.

### Organisation

#### Heads of Program:

■ Prof. Jérôme HUGUES

**E-mail:** jerome.hugues@isae.fr

■ Prof. Jean-Luc SCHARBARG

**E-mail:** jean-luc.scharbarg@enseeiht.fr

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

**Beginning of classes:** September

**Location:** ISAE and INP-ENSEEIH

**Teaching language:** English



### Learning approach

**First semester:** an academic session of 555 hours of teaching, provided by permanent professors of ISAE and INP-ENSEEIH and experts from industry bringing current knowledge and experience-Teaching activities include lectures, tutorials, and labs, a multidisciplinary project of one month that aims at integrating the academic session into an industrial case study.

**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 Organisation and from ISAE or INP-ENSEEIH. The thesis is concluded by the preparation of a report and an oral dissertation in front of jury.

### Syllabus

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

Hence, the academic session of the Master program consists of a 555 hours long program covering the five disciplinary fields while focusing on the architectural aspect and a set of application-oriented lectures and seminars.

#### Part 1 - Computer science - 47 h

Real time language, Architecture description language, Real time operating systems

#### Part 2 - Control systems - 60 h

Design and Validation of Discret Event System, Feedback Control, Signal Processing

#### Part 3 - Electronic - 76 h

Digital representation of analog signal, Microprocessor and DSP architecture, Architecture and Design of FPGA and ASIC integrated, Hardware and software synthesis and co-simulation, RF Front-end architecture

## Part 4 - Energy - 63 h

Actuator and converter control, Electromechanical and static energy converters, Autonomous energetic systems, Embedded electrical network

## Part 5 - Networks - 63 h

Embedded networks: an introduction, Specific buses and networks, Real time networks, Design and validation of real time protocols, Architecture of fault-tolerant buses, Dimensioning of an avionic network

## Part 6 - Embedded systems engineering - Applications - 117 h

Real time control of a space system, Hybrid Systems, System Engineering, Real time control of a mechatronic system, Aircraft technics, Introduction to space system (ISS), Automobile technics, Workshops

## Part 7 - Embedded systems engineering - Courses - 100 h

System Dependability, Certification, Embedded systems and computer Security, Optimization, Electromagnetic compatibility, Mechatronics integration, Risk management

## Part 8 - ISAE Information system user - 12 h

## Part 9 - Multi-disciplinary project - 26 h

## Career opportunities

Embedded Systems offer challenging career opportunities. The Master is designed either for young graduates or experienced engineers, who require a postgraduate program to enhance their technical and management skills. This Master concerns any industrial sectors where embedded systems are used: aeronautics, space, road, rail and sea, energy industry, communication systems, etc.

Career opportunities in this area are numerous and are growing in a variety of large and small companies. This Embedded Systems Master qualifies students for employment as designers, developers, research engineers and project managers in design and development of innovative embedded systems.

### Companies recruiting our students

Accenture, Airbus Group and its subsidiaries, Altran, Astek, Atos Origin, CS Communications & Systèmes, DCNS, Motorola, Realix, Safran, Seditec, Sogeti High Tech, Sopra Group, ESA, GE HEALTHCARE TECHNOLOGIES (India), Indian AirForce, Philips R&D (Netherland), Thales Alenia Space, SIGFOX, ...

## TESTIMONIES

### Nicolas CHATONNAY, France, Graduated in 2014, Software Architect at THALES ALENIA SPACE

*Why did you choose ISAE and apply for our master? What were your objectives?* After 10 years spent in the mobile phone industry as a software engineer, it was time for me to explore other industrial domains. I wanted to make a pause in my professional career, first to refresh some of my competencies, second to get the key notions on embedded systems and finally to ease my career reorientation. From an engineer perspective, it is still good to see other things and to challenge himself. This is why I decided to apply for the Embedded Systems Advanced Master program.

*According to your experience, which are the strong assets of the Master you did?* One of the strongest assets of the Master are the conferences held by several engineers and researchers from various industries (automotive, space, aeronautics). I really appreciated to hear their lectures and to dialogue with them. In addition, «Embedded Systems» encompass number of different topics such as software, hardware, networks, security, system engineering, etc.. The other strong asset of this master is that it covers all those main topics and provides the student key notions in various domains.

*Which are your career plans?* After the master, I was hired in a R&D department of a french satellite manufacturer. I use my previous professional experience and the additional competencies learnt during the Master to propose innovative software architectures in order to address the next challenges of embedded systems in Space industry.

### Jon REGUEIRO, Spain, Graduated in 2013, «Field Application Engineer» at SIGFOX

*Why did you choose ISAE and apply for our master? What were your objectives?* ISAE is very well known because of its excellence on the aeronautics and space domain. I chose this school because I am a passionate of aeronautics and I wanted to get closer to this industry. Moreover, I considered the Embedded Systems advanced master would help me add very competitive skills to my Telecommunication Engineer background.

*According to your experience, which are the strong assets of the Master you did?* This master helped me enlarge some competences I already had thanks to my background (RF communications, VHDL programming and networks). On the other hand, I got many classes on different subjects that I didn't know and that, in my opinion, match the needs of a challenging embedded system industry (Real time programming, control theory, aeronautics and automotive systems etc).

*Which are your career plans?* In the short term I would like to stay in France and get a deeper experience on the IoT and embedded systems domain. Later, my plan is to move to the US and join a challenging and innovative project on the same field.

## INCOSE certification in ISAE

At the end of the first semester, all EMS 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.

\*Associate Systems Engineering Professional



# Common ISAE's admission procedures

## Advanced Masters

### Academic requirements

Applicants must have a Master degree, or an equivalent degree in science or engineering, or a bachelor degree with 3 years of professional experience at least.

### Tuition fees 2017:

	EU		Out of EU	
	reduced tuition fees <sup>1</sup>	tuition fees	reduced tuition fees <sup>2</sup>	tuition fees <sup>3</sup>
EMS	7 500 €	12 500 €	12 500 €	18 000 €

<sup>1</sup> for students graduated in the year of enrollment or the year before and with no professional experience

<sup>2</sup> for individual applicants

<sup>3</sup> fees for public agencies and private companies available upon request from Philippe Galaup at: [philippe.galaup@isae.fr](mailto:philippe.galaup@isae.fr), Head of recruitment and Contractual Relations

Possibility of studies funding by the Midi-Pyrénées Regional Council for French and UE unemployed applicants.

## Selection and admission

### Admission to ISAE's master at:

<http://admissionsmasters.isae-supero.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 February to July 2016, see schedule on our website: [www.isae-supero.fr](http://www.isae-supero.fr)

### Application fees:

> 70 € (non-refundable)

## Language requirements

### Language qualification requested:

> TOEFL (IBT): 79 points (Inst. code: 9820)

> or TOEIC: 785 points

> or IELTS: 6.5 points

> or CAE.

## Your contacts at ISAE

**Philippe GALAUP**, *Head of recruitment and Contractual Relations* - Phone : +33 (5) 61 33 80 27

**Laurence BALLARIN**, *Senior Admission Advisor* - Phone : +33 (5) 61 33 80 22

**Marie GUIBBAL**, *Senior Admission Advisor* - Phone : +33 (5) 61 33 80 28

**Mikael LE ROUX**, *Senior Admission Advisor* - Phone: +33 (5) 61 33 80 13

[info-masters@isae-supero.fr](mailto:info-masters@isae-supero.fr)

# ISAE in few words

ISAE-SUPAERO is a world-class higher institute for aerospace engineering education and research. Nowadays with a student corpus of over 1600, ISAE-SUPAERO is one of Europe's largest Aerospace Institute offering graduate and postgraduate programs. Yearly, ISAE-SUPAERO awards around 20% of master's degrees in Europe in aeronautics and space field. ISAE-SUPAERO 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..

## Identity card



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

**Legal Status:** Public Institution of higher education and research.

**Endorsements and awards:** CTI agreement of the two «Diplôme d'ingénieur», Conference des "Grandes Écoles" for postgraduate Advanced Masters and "Ministry of Higher Education and Research" for Masters of Science.

**Faculty:** 100 professors and researchers.

**Employees:** 400.

## A campus fully renovated in 2015

ISAE-SUPAERO campus is located in Toulouse, along the Canal du Midi (UNESCO world heritage).

It is composed of:

- » wide range of sports facilities including swimming pool, tennis and squash courts, sports hall, football and rugby fields, climbing wall and fitness room,
- » 6 students halls of residence : 1000 rooms and studios apartments, all connected to high-speed network,
- » a restaurant.

The campus is located in the Ranguel scientific complex, close to:

- » ONERA French aerospace research centre
- » CNES - French space agency
- » 2 CNRS (National Center for Scientific Research) laboratories
- » University and engineering schools.

## Key figures

**1** «diplôme d'ingénieur» ISAE-SUPAERO in French

**1** Master of Science ISAE-SUPAERO in English

**1** «diplôme d'ingénieur par apprentissage»

CNAM-ISAE (co-op master program)

**15** Advanced Masters including 10 in English

**5** Masters in French

**6** PhD Programs

More than **1600** students including **1400**

masters and more than **220** PhDs

**81** international cooperation agreements



**a set to facilitate settlement of new students in Toulouse city.**

*Including: bank account opening, housing insurance, accommodation booking, immigration formalities, public transportation card, SIM card, Guided tour of Toulouse city*