Embedded Systems

OBJECTIVES

The embedded systems are the heart of automatic devices in our daily life. The design of embedded systems represents an economical stake for manufacturers: it increases the value of equipment and improves the competitiveness of companies. France has several worldwide industries in aerospace, military, and space industry, energy, rail, telecommunications, automotive, etc. which have been users
of embedded systems for decades: EADS, Thales, Airbus, Renault, etc.

The embedded systems major addresses the design, the implementation and the management of complex systems (aricraft, cars, trains…). The competencies involved are the design of standardized and reliable functioning hardware and software devices/ objects. The acquired knowledge covers the fields of electronics and software engineering at system-level design.

JOB PROSPECTS

Equipment manager, system expert, project manager, embedded platform architect, embedded technologies expert/support manager, embedded applications architect, Software Development expert, Qualification/ validation Expert, Test expert, integration expert/manager, process & methods/quality/ certification expert.

Course content

SEMESTER 1

COMPUTER MICROSYSTEMS
- C language programming: memory allocation, pointer and API
- Operating system description: process/thread/ memory/supervision, shell & system programming

PROJECT-BASED LEARNING IN ELECTRONIC AND SIGNAL
- Analog electronics: signal conditioning, analog filter, power management
- Digital electronics: microcontroller based sensor management, bluetooth link
- Fourier series and transform, sampling, digital filtering

NETWORK FUNDAMENTALS
- Network communication, communication channel
- Layer approach, OSI model, TCP/IP model
- Network devices, network addressing models

DATA SCIENCE FUNDAMENTALS
- Probability theory
- Statistics (descriptive statistics, statistical theory of estimation, hypothesis testing)
- Data science (principal component analysis, linear regression)

ELECTRONICS FOR IOT
- Deepening on Microcontroller
- Battery management, low power design, Power conversion
- Wireless link, protocoles and capabilities low power
- Green communication design, System implementation

INTRODUCTION TO RESEARCH
- Definition of research: procedures, organization and purposes
- Targeting information (specialized sites, books, open archives, etc.)
- Bibliographic study: synthesis of the research works
- Modeling a scientific problem
- Writing a scientific publication
- Ethics, integrity and scientific rigor

ENGLISH, FRENCH AND HUMANITIES COURSES

SEMESTER 2

ELECTRONIC MICROSYSTEMS
- Instruction set architecture
- Logic design, computer arithmetic
- CPU design, memory hierarchy
- Multicore and GPU models

DATA AQUISITION AND PROCESSING
- Data types: qualitative, quantitative
- Deterministic data processing: Data transforms, filtering, linear prediction
- Random data processing: Distributions, estimation, measure errors; correlation...

CYBERSECURITY
- Information systems security
- Web application and network security
- Introdution to Cryptography, etc.

ANALOG SYSTEMS
- Power electronics
- Noise and conditionning
- Amplification chain
- Analog to digital converters
- Radiofrequency communications

ENGLISH, FRENCH AND HUMANITIES COURSES

CHOOSE ONE COURSE AMONG:

INTRODUCTION TO ARTIFICIAL INTELLIGENCE
- Applications of artificial intelligence to problem solving
- Methods of problem formalization and knowledge representation
- Resolution algorithms associated with these representations

INTERNATIONAL BUSINESS INNOVATION PROJECT
- Build real business model in a multicultural team
- Create innovative idea with marketing & business strategies
- Present final business model to professionals

RESEARCH AND INNOVATION
MANAGERIAL TRAINING
ECO-DESIGN
PERSONAL AND CAREER

SEMESTER 3

SAFETY AND RISK ANALYSIS
- Failure trees – failure density, failure rate
- Reliability of components, of boards, of systems, life duration, physical failure analysis – methods and tests
- Redundant systems, serial, parallel, vote, triplication
- Coded systems
- Standards on quality, standards on safety
- Electromagnetic compatibility of systems

SYSTEM CONSTRAINTS AND IMPLEMENTATION
- Methodology development cycles and systems
- Life cycle of software, of hardware
- System simulation, tools for formal proof
- Real-time UML

PROJECT
The project is composed of an advanced case study. The students will be called upon to use the knowledge, design techniques and tools that they learnt through their courses

ENGLISH, FRENCH AND HUMANITIES COURSES

CHOOSE TWO COURSES AMONG:

AUTOMATIC CONTROL/REAL TIME
- System model, state space, optimum command theory
- States representation
- Reliability of components & cards

SMART CITIES / CONNECTED AND AUTONOMOUS VEHICLES
- Challenges of the smart city
- Instructions for a stronger economic development
- Industry 4.0 market technical
- Smart Transportation
- Aviation market techno-economic analysis

MEDICAL ROBOTICS
- Kinematics of medical robots
- Imaging guided medical robots
- Tracking and surgical navigation

MACHINE LEARNING
- Linear predictor, convex learning
- Gradient descent, Kernel Methods
- Support vector machine, Decision trees

SEMESTER 4

INTERNSHIP
The internship with an international company will enable students to display valuable professional skills and attitudes developed during the three academic semesters.
Isep will provide you with assistance in your search for an internship. Companies usually give a stipend to the trainees.

Syllabus: subject to minor modifications