MUTHOOT GLOBAL CENTRE FOR
EDUCATION AND RESEARCH, INDIA

ESIGELEC
SCHOOL OF ENGINEERING
SMART AND CONNECTED SYSTEMS
ROUEN | POITIERS

JOINT MSc.
IN
CONNECTED EMBEDDED INTELLIGENT SYSTEMS
(2024-2025)

Master of Science - MSc. in Connected Embedded Intelligent Systems
ESIGELEC, Graduate School of Engineering, France

Accredited by
CONFÉRENCE DES GRANDES ÉCOLES

BIENVENUE EN FRANCE

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GENERAL INFORMATION

ELIGIBILITY

A 4 year bachelor's degree in Electronics & Communication, Electrical & Electronics, Telecommunication, Computer Science or any other relevant branches in Engineering, with a minimum aggregate of 50%.

PROGRAMME OBJECTIVES

The Master's Programme in Connected Embedded Intelligent Systems, seeks to equip students with the relevant knowledge, professional skills, practical experience and basic management skills, for industry or for research. They will learn how to design, develop systems and equipment in the aeronautic, space, automobile and electronics sectors.

The mandatory internship gives students hands-on experience, in an international setting. Our graduates find job opportunities as developers, project managers, consultants or researchers.

The multicultural environment at ESIGELEC allows students to discover new cultures and languages.

DURATION

3 Semesters

The programme comprises two semesters of study, one semester each at MGCER, India and one at ESIGELEC, France. In semester 3, students are required to complete a mandatory internship in a company or in a laboratory (Ref. sections *semester 3*).

The maximum permissible duration to complete the programme and obtain the degree is of 3 years

PROGRAMME STRUCTURE

SEMESTER 1 (JULY-DECEMBER 2024)

Location: MUTHOOT GLOBAL CENTRE FOR EDUCATION AND RESEARCH, India

Course delivery: lectures, tutorials, practical work, projects and seminars.

Evaluation: tests, quizzes, oral & written exams, etc. conducted on a regular basis

Faculty: MGCER, India

The rules and regulations for this semester are prescribed by MGCER, India (approved by ESIGELEC).

SEMESTER 2 (FEBRUARY 2025-JULY 2025)

Location: ESIGELEC, France

Course delivery: lectures, tutorials, practical work, projects.

Evaluation: tests, quizzes, oral & written exams, etc. conducted on a regular basis

Faculty: ESIGELEC, partner universities, industry captains from France and / or abroad.

The rules and regulations for this semester are prescribed by ESIGELEC (approved by MGCER, India).

SEMESTER 3: INDUSTRIAL / RESEARCH INTERNSHIP(S)

In the third semester, students must do a mandatory internship in a laboratory or in industry, for a period of 4 months (min.) to 6 months (max.).

While ESIGELEC and / or MGCER, India provide assistance to find internships, students are expected to play an active part, as internships are not provided automatically.

SEMESTER ONE

MUTHOOT GLOBAL CENTRE FOR EDUCATION AND RESEARCH, INDIA

Module Summary

SEMESTER 1 – MGCER, INDIA: JULY 2022 - DECEMBER 2022								
Module Name	Hrs / Week				Exam Duration (hrs)	Maximum Marks		
	Lecture	Tutorial	Practical	Credits		Internal Assessment	Final Exam	Total
Data Structures & Algorithms	3			3	3	50	50	**100**
Fundamentals of Machine Learning	3			3	3	50	50	**100**
Embedded Systems	3			3	3	50	50	**100**
Elective 1	3			3	3	50	50	**100**
Microcontrollers & its Applications	3			3	3	50	50	**100**
Data Structures & Algorithms - Lab			3	1	3	50	50	**100**
Microcontrollers & its Applications - Lab			3	1	3	50	50	**100**
Fundamentals of Machine Learning -Lab			3	1	3	50	50	**100**
Embedded Systems - Lab			3	1	3	50	50	**100**
Elective 1 - Lab			3	1	3	50	50	**100**
Minor Project 1				4		100		**100**
Seminar 1				1		100		**100**
French Language - 1*	5			5	3	100		**100**
TOTAL	**535 HOURS / 30 CREDITS**							

List of Electives

MGCER, India
Elective - 1
DotNet Technologies
Advanced Programming Techniques
Linux & Scripting Languages
Internet of Things

All modules are delivered face-to-face, on campus, with all required safety measures. However, modules may be delivered partially or totally online and/or through distance mode, in keeping with possible changes in the health crisis or any other circumstances beyond our control and as advised by the relevant Indian Government authorities

module description

Data Structures & Algorithms

Module Code: ESI 601 Duration: 72h

Objectives:

At the end of this module students will be able to:

- Analyze algorithms
- Analyze basic recursive programs, solve a general class of recurrence relations
- Design programs for implementation of linked lists, stack and queues
- Design programs for sorting and searching
- Explain sets and design dictionary and hash tables
- Design trees and binary search trees
- Design graphs for implementing spanning trees and shortest path algorithms
- Illustrate application of divide and conquer technique, dynamic programming, greedy technique and back tracking

List of topics:

- Introduction to Data structure, Algorithms and problem solving
- Elementary data structures – Linked list, Stack, Queue, Tree, Sets
- Graphs and its applications
- Sorting and Searching Techniques
- Algorithm design techniques and analysis of algorithms

This module will also help students to improve their programming skills.

Fundamentals of Machine Learning

Module Code: BDA 601 Duration: 72h

Objectives:

At the end of this module students will be able to:

- Identify the software and tools for designing machine learning applications
- Apply concept learning and hypothesis space
- Apply machine learning approach to reduce the dimension
- Analyse different machine learning algorithms
- Design ensemble methods

List of Topics

- Introduction to Machine Learning
- Inductive Classification
- Decision Tree learning
- Computational learning theory
- Bayesian learning, Instance-based learning
- Continuous Latent Variables
- Ensemble methods (bagging and boosting)

Embedded Systems

Module Code: ESI 609 Duration: 72h

Objectives:

At the end of this module students will be able to:

- Employ the knowledge of ARM Processor architecture in programming ARM Microcontrollers
- Explain the concept of Memory map, Processor Modes, Banked Registers, Interrupts and Exception Handling of ARM Processor
- Employ the knowledge of Microcontrollers to build Real Time Embedded systems
- Explain the concept of Programming ARM Microcontrollers using Assembly and Embedded C
- Design a Real Time Embedded Systems by interfacing Sensors and Actuators and porting Real time operating systems

List of topics:

- Introduction to Embedded Systems
- ARM Cortex processor
- Instruction Set Architecture
- LPC13/17xx Microcontroller
- Data Acquisition System: ADC, DAC
- Serial Communication: UART – I2C – SPI
- USB, CAN Bus
- Multitasking in Microcontrollers
- Designing a Digital Camera

Dot Net Technologies

Module code: ESI 615.3 Duration: 72h

Objectives:

At the end of this module, the student will be able to:

- Understand the working principles of dot net framework
- Use Object-oriented programming features offered by C#
- Design and implement desktop application using ADO.Net
- Design and build web application using ASP.Net

List of topics:

- Introducing C# and the .NET Platform:
  - The philosophy of .NET, Building C# Applications.
- The C# Programming language:
  - Fundamentals, Object-Oriented Programming with C# 2.0,
  - Understanding Object Lifetime, Understanding Structured Exception Handling,
  - Interfaces and Collections, Callback Interfaces, Delegates, and Events.
- Programming with the .NET Libraries:
  - The System.IO Namespace, Understanding Object Serialization,
  - Building Better Window with System Window Forms,
  - Rendering Graphical Data with GDI, Programming with Window Forms Controls,
  - Database Access with ADO.NET.
- Web Applications and XML Web Services:
  - ASP.NET 2.0 Web Pages and Web Controls, ASP.NET 2.0 Web Applications

Advanced Programming Techniques

Module code: MIS 506 Duration: 72h

Objectives:

At the end of this module, the student will be able to:

- Explain major principles of object-oriented programming concepts and apply it in an application using java programming language
- Discuss the basic structures of a java application and Develop UI based application using swing components
- Write a java application for multi thread programming
- Apply collection framework and utility library in java applications

List of Topics

- Coding patterns – Structural vs. procedural languages
- Introduction to OOPS concept – Data Abstraction - Encapsulation – Polymorphism – Inheritance
- JAVA language constructs – Applications and Applets
- Java GUIs, JAVA Beans
- The Java Library – The Collection Framework, Utility classes

Linux & Scripting languages

Module code: AES 615.1 Duration:72h

Objectives:

At the end of this module students will be able to:

- Relate the Linux operating system in real world applications
- Name the different shell command interpreters, Operate Linux System and understanding of shell scripting features
- Write shell script programmatically using different features and debugging the code
- Write pattern matching using grep, sed, awk, perl commands
- Schedule the task using shell script
- Create an application using dialog utility
- Operate SED & AWK commands to do more complex task in easy way
- Generate a report using AWK commands
- Differentiate between globbing and pattern matching operators
- Create Make file
- Write PERL scripts that create and change scalar, array and hash variables
- Use control structures to branch or loop in PERL
- Read and write in a file using PERL file handle

* This course will help the students to understand the various tools available in Linux and be able to write shell scripts using sed, awk, grep commands, and how to apply them to the problem

List of topics:

- Shell scripting
- Dialog utility
- Power utilities like cut, paste, grep, tr, uniq
- Sed
- AWK
- PERL
- Make file

Internet of Things

Module code: ESI 615.5 Duration: 72h

Objectives:

At the end of this module, the student will be able to:

- Illustrate the IoT Protocols and IoT architecture.
- Write basic python programming.
- Explain the wireless sensor network protocol standards, issues, routing design and applications
- Illustrate the Bluetooth architecture, stack, profile
- Explain Zigbee protocol stack, different layers, and communication
- Distinguish between IPv4 and IPv6
- Explain 6LoWPAN architecture
- Design and develop database and web server for some IoT Frameworks

List of topics:

- IoT Protocols
- Introduction to Python
- Wireless Sensor Networks
- Protocols – Bluetooth, Zigbee
- Internet Protocol
- 6LoWPAN - 6LoWPAN architecture
- Sockets
- Databases & Web Programming

Microcontrollers & its Applications

Module Code: ESI 607 Duration: 72h

Objectives:

At the end of this module the students will be able to:

- Explain the architecture of Microcontrollers
- Explain the concepts of Communication protocols, Memory map, Interrupts and Exception handlers of Microcontrollers
- Employ the knowledge of Microcontrollers to build embedded systems
- Explain the concept of Programming Microcontrollers using Assembly and Embedded C
- Design Embedded Systems by interfacing Sensors and Actuators

List of topics:

- Introduction to Microprocessors & Microcontrollers
- ARM Microcontrollers
- Reset Circuitry, Relays and Timers
- Serial vs Parallel Buses
- Introduction to SPI and I2C Protocol, Interfacing with SPI and I2C Devices – RTC
- ADC and DAC

Minor Project 1

Module code: AES 695 Duration: 75h

Objectives:

At the end of the course student shall be able to:

- Search and identify the most relevant technical problem to be implemented
- Learn to gather related and relevant information related to the identified problem
- Design hardware/software, algorithms, flowchart, and block diagrams
- Learn to Analyze the results
- Justify the methodology used
- Develop the skill to write a technical report and paper

Seminar 1

Module code: AES 697 **Duration: 20h**

Objectives:

At the end of this module, the student will be able to:

- Search and identify a most relevant technical topic for presentation
- Learn to identify a current and relevant research topic
- Develop the skill to write a technical report
- Learn to design an effective technical presentation slides
- Improve overall presentation skills
- Develop the ability to work in groups to review and modify technical content

French Language 1

Module code: AES 637 Duration: 60h

Objectives:

At the end of this module, students will be able to:

- Listen (basic everyday situations)
- Read (basic everyday situations)
- Write (basic everyday situations)
- Speak (basic everyday situations)

SEMESTER TWO
ESIGELEC, FRANCE

Module Summary

SEMESTER 2 - ESIGELEC, FRANCE: FEBRUARY 2023 TO JULY 2023		
Module	**ECTS**	**Duration (Hours)**
Virtual Instrumentation	3	15h (Course) + 15h (Lab)
Specific Instrumentation	3	15h (Course) + 15h (Lab)
Embedded C Programming	3	15h (Course) + 15h (Lab)
Elective 2	3	30h
R&D Project	5	60h (Project)
Project Management	2	26h
Artificial Intelligence for Smart Systems	3	15h (Course) + 15h (Lab)
Smart Sensors	3	15h (Course) + 15h (Lab)
Oral Communication	1	15h (Course)
French Language 2*	4	60h (Course)
345 HOURS / 30 CREDITS		

List of Electives

ESIGELEC, France
Elective - 2
Module
Real-time Operating Systems
Embedded Java
Mobile Robotics & Perception
Embedded Linux
EMC Automotive Systems

All modules are delivered face-to-face, on campus, with all required safety measures. However, modules may be delivered partially or totally online and/or through distance mode, in keeping with possible changes in the health crisis or any other circumstances beyond our control and as advised by the relevant French Government authorities

ESIGELEC PARTNER AWARD - AWARDED BY ESIGELEC

- Eligibility: Student with the highest academic score at the end of the programme

module description

Virtual Instrumentation

Module code: MSCCEIS01 Duration: 30h

Objectives:

At the end of this module, students will be able to:

- Use LabVIEW to create applications
- Understand front panels, block diagrams, and icons and connector panes
- Use built-in LabVIEW functions
- Create and save programs in LabVIEW so students can use them as subroutines
- Create applications that use plug-in DAQ devices. The application must respect standard LabVIEW practices (taken from the Certified LabVIEW Developer (CLD) test) and use a modular and evolving architecture
- Design a program with LabVIEW for an electrocardiogram that monitors real and "noisy" data. This program must:
  - Respect design standards
  - Use standard programming

List of topics:

- Fundamental programming notions in LabVIEW
- LabVIEW programming
- Creating an interface
- Learning good LabVIEW practices for form and structure in programming

Specific Instrumentation

Module Code: MSTSEE29 Duration: 30h

Objectives:

At the end of this module, students will be able to:

- Manage the entire information sampling chain in an instrumentation-type embedded system

List of topics:

- The measurement chain:
  - From the physical signal to digital processing
- Sensors:
  - Types
  - Technology
- Signal conditioning:
  - Transport
  - Filtering
  - Amplification
- Sampling:
  - Period
  - Response time
- Information security:
  - Accuracy
  - Llifetime
  - Redundancy

Embedded C Programming

Module Code: MSCCEIS03 Duration: 30h

Objectives:

At the end of this module, students will be:

- Familiar with the C coding practices for embedded systems
- Familiar with the elements and tools for embedded software validation
- Able to develop, write and test a C language program (as per design specifications) to be used with a microprocessor with respect of good practices like MISRA-C rules
- Able to analyse and enumerate the various phases of development for a software project: the V cycle
- Able to program a microcontroller and develop embedded applications. These applications will deal with digital inputs/outputs, analog signals and will create delays and time events by means of hardware timer
- Able to apply techniques and rules to ensure software quality and best coding practices (A sizeable part of the course is devoted to programming the microcontroller)

List of topics:

- Specificities of C Language for embedded systems (variables, memory organization, physical address access, etc.)
- Introduction to embedded system and programming methods
- Software analysis and validation tools and principles for embedded systems
- C language for embedded systems
- Best coding practices
- Programming the MSP430 microcontroller

Real-time Operating Systems

Module Code: MSTSEE24 Duration: 30h

Objectives:

At the end of this module, students will be able to:

- Understand why real-time executive is used in embedded systems
- Describe the four major categories of services provided by an executive
- Describe the necessary required materials to implement an executive in real-time
- Learn the various commercial aspects of executive suppliers
- Describe the role of scheduling, how it works and the major variations
- Calculate task times for simple situations
- List attribution rules for task priority
- Describe how the principle elements for synchronization are presented in executives
- Describe the characteristics and how an email inbox works
- Design and develop a simple multitasking application with MicroC / OSI

List of topics:

- Fundamentals of multitasking and real-time
- A scheduler: its role and how it works
- Why real-time executives are used in embedded systems
- Necessary materials
- Categories of executives and their markets
- A real-time kernel: MicroC/OSII (Micro-Controller Operating Systems Version 2)
- Memory management
- Intertask communication and synchronization tools
- Using MicroC/OSII and microcontrollers

Embedded Java

Module Code: MSTSEE27 Duration: 30h

Objectives:

At the end of this module, students will:

- Be familiar with a computer language which can be used to develop graphic applications under Windows for personal embedded systems like Pocket PCs

List of topics:

- Java ME environment: interface and syntax
- Basics of programming in the Java ME environment

Mobile Robotics & Perception

Module Code: MSCCEIS04 Duration: 30h

Objectives:

At the end of this module, students will be able to:

- Name the name and function of the different elements of a mobile robot
- Describe the architecture of a mobile robot
- Design, code and test an algorithm allowing the robot to move while avoiding obstacles
- Cite the problems of mobile robotics: modeling, trajectory planning, localization, navigation

List of topics:

- Introduction to Mobile Robotics
- Sensors used in mobile robotics
- Actuators used in mobile robotics
- The different mobile platforms
- Modeling and Control Laws in Mobile Robotics
- Location
- Navigation and trajectory planning

Embedded Linux

Module Code: MSCAES07 Duration: 30h

Objectives:

At the end of this module, students will:

- Understand the possibilities and uses of the Linux kernel for an embedded IT project.
- Learn the principle software tools used in the Linux/Unix world and how to use them to develop.
- Be able to write a device driver for specific Linux run material
- Be able to combine tools to create advanced functions with a minimum of programming

List of topics:

- Introduction to Linux.
- How an OS fits in an embedded system.
- History of Linux and Unix systems.
- Linux compared to other embedded operating systems.
- Fundamental tools: command lines, shell scripts.
- Linux development tools.
- C programming with embedded systems.
- Linux drivers.
- Web connections and Remote Administration Tools (RATs)

EMC Automotive Systems

Module Code: MSCAES06 Duration: 30h

Objectives:

At the end of this module, students will:

- Understand EMC System architecture
- Understand Integrity signal and how to calculate it
- Understand EMC of components and how to protect electronic system
- Understand near field and interactions with the environment

List of topics:

- EMC Introduction
- Integrity Signal (IS)
- EMC of components
- Near-field

R&D Project

Module Code: MSCCEISRDPRJ Duration: 60h

Objectives:

At the end of this module, students will be able to:

- Design, develop and realize an embedded system in mobile robotics and embedded electronics
- Develop technical solutions-based electronic equipment or an electronic board: hardware and software
- Test the platform developed
- Develop and carry out an embedded system platform successfully
- Manage a technical project

List of topics:

- Project Management:
  - Benchmarking study
  - Technical and Functional specifications
  - Architecture Design and Risk analysis
  - Test protocol
- Technical Development:
  - Image processing and computer vision systems:
    - Image segmentation
    - Pattern recognition
    - Object detection and tracking
  - Artificial Intelligence and Deep Learning Applications for mobile robotics and electronic applications
  - Dataset collection
  - Mobile robotics and autonomous navigation
  - IoT and sensors
  - Smart mobility

Project Management

Module Code: MSCCEISPRMG Duration: 26h

Objectives:

At the end of this module, students will be able to:

- Appreciate the need for project management including formal methods, as a recognized discipline
- Understand the complexities of different types of computing projects and some of the methods used to manage them
- Appreciate the need to break up complex projects
- Appreciate the need for effective planning, monitoring and control mechanisms
- Understand the need for formal project management organizational structures
- Understand the importance and management of stakeholders in an international project
- Apply some of the skills and knowledge learned in any future project (including during other module(s) of this course, and, in particular, documentation for development project)
- Understand the complexity of a technical project and the need for formal methods

List of topics:

- What is a project? The need for PM, formal methods
- Managing large, complex, international projects
- Un peu de franglais (PM culture and language in English and in French)
- Management of projects, project life cycle, roles of the project manager and stakeholders
- Stakeholder management, scope, creep

- Work planning, project breakdown structures and estimating
- Resource planning, estimating, management
- Risk identification, analysis, management
- PERT and Gantt charts, their use and shortcomings
- PM planning tools (including practical sessions with MS Project)
- Change control, documentation, configuration management
- Project control, quality, documentation, delivery management
- Project closure; maintenance projects
- Types of computing projects and risks; computing PM methods
- Cost-benefit analysis and project accounting may be touched upon, but are not in the scope of this course

Artificial Intelligence for Smart Systems

Module Code: MSCCEIS04 Duration: 30h

Objectives:

At the end of this module, students will be able to:

- Identify artificial intelligence problems in the smart embedded systems field.
- Describe the principle of some of the most widespread artificial intelligence methods
- Develop a basic scenario as an application for a smart embedded system: for example autonomous mobile robot problem, using existing building blocks and software tools

List of topics:

- Artificial intelligence issues
- Possible applications in the field of mobile robotics: recognition of road signs, obstacles, pedestrians, faces, etc.
- Study of some of the most widespread methods
- Existing systems in the automotive field
- Implementation: C/C++ programming, Scilab, python, and use of the OpenCV library

Smart Sensors

Module Code: MSTSEE32 Duration: 30h

Objectives:

At the end of this module, students will be able to:

- Describe the typical internal architecture of such a sensor, the advantages and disadvantages associated with it and the current uses of this type of system
- Understand the complexity and the benefits of using this kind of technology

List of topics:

- "Smart" vs "dumb" sensors
- Observer (human) effect and Schrödinger's cat dilemma in sensing
- Statistical modeling of sensing/measurements
- Signal processing for smart sensing
- Communication systems
- Case studies

Oral Communication

Module Code: MSCAES10 Duration: 15h

Objectives:

At the end of this module, students will:

- Have a clear model of what constitutes successful and unsuccessful presentations
- Have practiced giving formal presentations in English
- Be more aware of their own shortcomings when presenting
- Practice and perfect final presentation skills
- Learn the importance of structure and how formal prepared speech differs from everyday social interactions
- Work with their presenting strengths and weaknesses via several short practice presentations and a final (individual and/or group) presentation

List of topics:

- Methods for creating a final presentation
- Practice

French Language 2

Module Code: MSCAESLANG Duration: 64h

Objectives:

At the end of this module, students will be able to:

- Understand standard French used in everyday situations at work, school, etc. (Oral comprehension)
- Understand texts written in standard French used in everyday situations such at work, school, etc. (Written comprehension)
- Participate in a regular day-to-day conversation on familiar topics (Oral expression)
- Ask and exchange information (Oral expression)
- Prepare and give a short formal presentation (Oral expression)
- Write short, clear and coherent texts on familiar/everyday situations with basic grammar and vocabulary (Written expression)

List of topics:

- Revision of grammar and vocabulary
- Preparation for the Test of French Language (TCF or TEF)

SEMESTER THREE INTERNSHIP

THE INTERNSHIP SEMESTER

The internship can be done either in a company or in a research laboratory, anywhere in the world. The duration of the internship is of 4 months (min.) to 6 months (max.). While ESIGELEC will provide assistance, students are expected to play an active part, as the internships are not offered automatically.

Once a student has found an internship, the internship form, providing all required information must be filled and submitted to the Internship Department at ESIGELEC. The Head of the Internship Department and the Academic Coordinator of the Master's Program must approve, thereafter the company / research laboratory, ESIGELEC and the student will sign the Internship Agreement. A copy of this agreement is retained by ESIGELEC, the company / research laboratory and the student. A faculty member of ESIGELEC will contact / visit the student once during his / her internship. This faculty member and the Academic Coordinator of the Master's Program will be the contact persons for any questions the student may have about the internship, the thesis and the oral presentation.

The thesis:

The topic of the thesis, chosen by the student, must be communicated to the Academic Coordinator of the Master's Program for approval, within one month of starting the internship. A soft copy of this thesis must be submitted to ESIGELEC via intranet at least 2 weeks before the oral presentation.

The oral presentation:

A Board of examiners comprising a President, one faculty member from ESIGELEC and the industrial tutor (if possible) will be convened for the oral presentation conducted by the student and it must be done within four months, at the latest, of completion of the internship. The total duration of the oral presentation will be of 60 minutes (Presentation – 30 minutes + Q&A - 15 minutes + Deliberation among members of the Board of examiners).

The faculty member assigned for supervision and the Academic Coordinator of the Master's Program will be the contact persons for any questions the student may have about the internship, the thesis or the oral presentation.

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