International programmes

for incoming exchange students

Ecole Nationale Supérieure de Cognitique - ENSC

2024-2025

Introduction

ENSC is one of the engineering school of Institut Polytechnique de Bordeaux ("Bordeaux INP"). It offers a 3-years training programme (Master level) in the main disciplines of engineering, with a specific focus on cognitive engineering, which relates to the design, analysis and tests of complex systems that require complex human systems interactions. To better understand what is taught at ENSC, you may take a look at the main disciplines of our training programme:

- Computer science, advanced programming, data bases, web technologies.
- Cognitive psychology, basics of neuropsychology, ergonomics.
- Human systems interactions, human factors, human centered design.
- Artificial intelligence, machine learning, basics of robotics.
- Statistics, signal processing.
- Project management, knowledge management.

1. Studies proposed in French language

The training programme is organized in 6 semesters:

- Bachelor level: Semester 5 and 6, see annex 1.1 and 1.2.
- Master level, year 1, semester 7 and 8, see annex 2.1 and 2.2.
- Master level, year 2, semester 9 and 10, see annex 3.1 and 3.2.

2. Studies proposed in English

2.1 Specialization in Robotics, master level, 60 ECTS

This specialization corresponds to 1 of the 4 options of the last year of the ENSC engineering programme (master of Science level). It is organized in 2 semesters. The first semester is dedicated to specialized courses and the 2nd semester is a 6 months internship in a company or in a laboratory. The programme is in English (English spoken, or at least documents and examination in English). See annex 4 for more details.

2.2 Masters of Science in Cognitics Engineering, 60 ECTS

This programme is offered to exchange students from partners universities. See annex 5.

2.3 Tailor made courses selection

You may eventually try to select a list of courses taught in English « à la carte ». See what is proposed by ENSC. See annex 6 and 7.

Annex 1.1

COS50015 SEMESTRE 5 COGNITIQUE

CO5INGL0 UE Culture Ingénieur et Langue	**2.00 ECTS**
CO5INLV0 Langue Vivante 1 *(choisir 1 parmi 2 éléments)*	
CO5INAN0 Anglais	24h
CO5INAL0 Autre Langue Vivante	24h
CO5INLD0 Langue vivante 2 (optionnel)	0h
CO5INCE0 Culture, Expression et Comportement	18h
CO5SCOG0 UE Ingénierie Cognitique	**12.00 ECTS**
CO5SCCC0 Cognitique et bases de la cognition	44h
CO5SCFH0 Facteurs humains, Utilisabilité et UX	42h
CO5SCBI0 Bases de la biologie humaine et neurobiologie	48h
CO5SFON0 UE Sciences fondamentales	**11.00 ECTS**
CO5SFBD0 Bases de données et programmation web	39h
CO5SFIN0 Introduction à la programmation	54h
CO5SFMA0 Probabilités et statistique	28h
CO5PRST0 UE Projets	**5.00 ECTS**
CO5PRTD0 Projet transdisciplinaire	3h
CO5PRTP0 Projet transpromotion	0h

Annex 1.2

COS60015 SEMESTRE 6 COGNITIQUE

CO6INGL0 UE Culture Ingénieur et Langue	**5.00 ECTS**
CO6INGP0 Gestion de projet, Ingénierie de conception	56h
CO6INLV0 Langue Vivante 1 *(choisir 1 parmi 2 éléments)*	
CO6INAN0 Anglais	30h
CO6INAL0 Autre Langue Vivante	30h
CO6INLD0 Langue vivante 2 (optionnel)	0h
CO6INCE0 Culture, Expression et Comportement	3h
CO6IN3I0 International, Interculturel, Interdisciplinaire	12h
CO6SCOG0 UE Ingénierie Cognitique	**8.00 ECTS**
CO6SCCR0 Connaissances et représentation	63h
CO6SCCC0 Gestion des connaissances et des compétences	52h
CO6SFON0 UE Sciences fondamentales	**13.00 ECTS**
CO6SFCW0 Communication Web	52.4h
CO6SFPA0 Programmation avancée	54h
CO6SFMA0 Statistique inférentielle et analyse de données	28h
CO6SFSS0 Signaux et systèmes	57h
CO6PRST0 UE Projet et Stage	**4.00 ECTS**
CO6PRTD0 Projet transdisciplinaire	0h
CO6PRSI0 Stage d'initiation	0h

Annex 2.1

COS70015 SEMESTRE 7 COGNITIQUE

CO7INGL0 UE Culture Ingénieur et Langue	**5.00 ECTS**
CO7INAE0 Accompagnement vers l'entreprise	18h
CO7INLV0 Langue Vivante 1 *(choisir 1 parmi 3 éléments)*	
CO7INAN0 Anglais TOEIC	27h
CO7INAI0 Anglais IELTS	27h
CO7INAL0 Autre Langue Vivante	27h
CO7INLD0 Langue vivante 2 (optionnel)	0h
CO7INCE0 Culture, Expression et Comportement	15h
CO7SCOG0 UE Ingénierie Cognitique	**10.00 ECTS**
CO7SCEH0 Ingénierie Cognitique et Interaction Homme Système	33h
CO7SCHS0 Interfaces Humain-Systèmes	44h
CO7SCIA0 Bases de l'intelligence artificielle	25h
CO7SCTC0 Technologies cognitiques	36h
CO7SFON0 UE Sciences fondamentales	**13.00 ECTS**
CO7SFMA1 Modélisation statistique et systèmes dynamiques	37.33h
CO7SFGL0 Génie logiciel	54h
CO7SFTS0 Traitement du signal	53h
CO7PRST0 UE Projet	**2.00 ECTS**
CO7PRTP0 Projet Transpromotion	2h

Annex 2.2

COS80015 SEMESTRE 8 COGNITIQUE

CO8INGL0 UE Culture ingénieur et langue	**5.00 ECTS**
CO8INMN0 Enjeux de l'entreprise	46h
CO8INLV0 Langue Vivante 1 *(choisir 1 parmi 2 éléments)*	
CO8INAN0 Anglais opérationnel	24h
CO8INAL0 Autre Langue Vivante	24h
CO8INLD0 Langue vivante 2 (optionnel)	0h
CO8INCE0 Culture, Expression et Comportement	15h
CO8SCOG0 UE Ingénierie Cognitique	**13.00 ECTS**
CO8SCFH0 Facteurs humains et ingénierie cognitique	32h
CO8SCSU0 Système d'aide et de suppléance & Méthodes de conception adaptées	56h
CO8SCIA0 Apprentissage automatique	32h
CO8SCHS0 Interfaces Humain-Systèmes	28h
CO8SCTC0 Technologies cognitives avancées	30h
CO8SFON0 UE Sciences fondamentales	**8.00 ECTS**
CO8SFMA1 Modélisation mathématiques	35h
CO8SFPI0 Projet informatique individuel	12h
CO8SFCA0 Commande et Automatique	27h
CO8SFDM0 Développement mobile	37h
CO8PRST0 UE Stage	**4.00 ECTS**
CO8PRSP0 Stage d'application	0h

Annex 3.1

Annex 3.2

COS00015 SEMESTRE 10 COGNITIQUE

CO0PRST0 UE Stage de fin d'études	30.00 ECTS
CO0STSP0 Stage de fin d'études	0h

Annex 4: Specialization in robotics

(Master of Science level – ENSC / ENSEIRB-MATMECA)

This program is jointly proposed by ENSC and ENSEIRB-MATMECA engineering schools. Courses are proposed in English or in French with English documents.

Technical skills required (minimum): Bachelor of science in Mathematics or Computer Science, or Mechanics, or Electrical engineering (or equivalent).

English level required: B2

Places: 20 (priority is given to students from ENSC, ENSEIRB-MATMECA and students from partners' universities)

Duration: 1 year

Organization: 1st semester: Courses (Sept. – January), 2nd semester: Internship (February, July-August)

Contact: jean-marc.salotti@ensc.fr   denis.lapoire@enseirb-matmeca.fr

EI9ROA UE I9ROBOT-A – Design, command and control of robotic systems – 4 ECTS

Command and Control (6h)
The aim of the course is to briefly present the robot control. After a brief reminder of the modeling tools developed (geometric, kinematic and dynamic models) and of the principle of PID type axis regulation, the main control architecture of robotic systems are presented. Two practical work sessions will illustrate the course.

Robot models and performance analysis (30h)
The objective of this course is to present the basic concepts of robotics, to allow students start reading more advanced texts. A student who has followed this course must have a rigorous and systematic approach to describe a manipulator robot: models geometric, kinematic and dynamic, forces and torques. He must also have knowledge language and basic concepts of robotics (Denavit Hartenberg, degrees of freedom, singularities, Jacobian matrix).

Numerical methods for robotics (20h)
The purpose of this course is to present a set of mathematical concepts required for modeling and controlling robotic systems.

EI9ROB UE I9ROBOT-B - IA and robotics – 7 ECTS

Machine learning for autonomous robots (10h)
In machine learning, there is a set of proven statistical techniques that can to a certain extent be compared to forms of learning in living organisms. However, their implementation in autonomous robotics highlights a certain number of weaknesses in ensuring the

autonomy of the agent. The aim of this course is to revisit these techniques in the light of data from neurosciences and social sciences to present algorithms allowing learning in autonomy, by simple interaction with the environment and with survival criteria defined a priori.

Human robot interactions (23h)

This course is an introduction to cobotics (collaborative robotics), with a focus on industrial applications, safety and human factors issues. 15 hours of practice are included, with the use of UR3 robotic arms and NAO or Pepper humanoid robots.

Computer vision for robotics (44h)

Introduction to the existing methods and libraries to process images and videos in the context of robotics, from edge detection to object and face recognition in real time.

Automatic planning in robotics (10h)

Planning in A.I., how to determine a list of actions to find a path or to achieve a goal, application to Robotics.

EI9ROC UE I9ROBOT-C – Embedded systems – 4 ECTS

Energy autonomy (10h)

This module deals with the conversion and management of electrical energy for the two main robotics needs of power supply on the one hand and actuator motor control on the other. Although closely related, these aspects of power electronics are dealt with in two separate parts.

Mechatronics (16h)

This course is dedicated to electronic, electrical and mechanical engineering issues in the design of robotic systems.

Embedded systems project (21h)

Application of mechatronics.

EI9ROD UE I9ROBOT-D – Robotics project – 5 ECTS

State of the art and methodology (20h)

Introduction to research methodology, addressing issues, state of the art, referencing.

Robotic project (20h)

Groups of 3 to 4 students work on a robotic project under the direction of a supervisor.

EI9ROE UE I9ROBOT-E – Professional integration – 5 ECTS

EI9AU324 First conception of robot (35h)

The objective is to design, build and program a small autonomous robot to carry out a mission. This will allow each of the groups of 3 student engineers to understand each of the disciplines of the training in a real situation (first week).

Several workshops are organized each year in conjunction with special events. Indicative list:

- AI for Industry workshop
- Robot Operating System (ROS) workshop
- Robot Maker's Day

EE9AM2F Languages and engineering culture – 5 ECTS

- Professional project
- English
- Entrepreneur challenge
- Student involvement (optional)

Annex 5: Masters of Science in Cognitive Engineering

Requirements: Bachelor in Mathematics/Physics/Computer science/Cognitive engineering

First semester, September to January (30 ECTS)

Mandatory courses, 21 ECTS :
1) Project in cognitive engineering, 15 ECTS
In the field of cognitive engineering, it is in general required to design an experiment involving users in order to test human systems interactions. Under the supervision of a professor, a group of students (1 to 3) has to work on a specific cognitive engineering project to gain a practical experience on that subject. Some time might be spent in a laboratory.
Examples of research teams involved in cognitive engineering projects:
- Cognitics and Human Engineering team of the IMS laboratory
- Auctus team from Inria (collaborative robotics).
Evaluation : Report and oral presentation

2) Literature review, 3CTS
A list of books and technical articles is provided to each student in order to complete their knowledge on a specific topic of cognitive engineering. A structured synthesis of what has been read must be written.
Evaluation : 10 pages report presenting the review.

3) Français Langue Etrangère (3 ECTS)
French lessons according to level.

Optional courses : 9 ECTS
Choose at least 2 options among the following list and 1 option in the following list and in the list of possible modules proposed by other Bordeaux INP engineering schools
a) Human Robot Interactions, 3 ECTS
   Physical and cognitive human robot interaction ; risk issues ; teleoperation, exoskeleton, cobotics ; practice: use of robotic arm (UR3) and humanoid robots

b) Basics of Artificial Intelligence, 3 ECTS (skill requirement: advanced programming)
   Minmax, graphs, general problem solving, heuristic search (A*), genetic algorithms

c) Human Factors and Human System Interactions, 3 ECTS
   Understanding human limits, management of cognitive resources, decision making, human errors, UX and human factors

d) Planning, 3 ECTS
   Planning in A.I., how to determine a list of actions to find a path or to achieve a goal, application to Robotics.

Second semester, February to July (30 ECTS)

5 to 6 months internship in a laboratory or company, in France or abroad, in the domain of cognitive engineering and artificial intelligence. Evaluation : Report and oral presentation.
Director: Jean-Marc Salotti   Contact: jean-marc.salotti@ensc.fr

Annex 6: Tailor made courses selection

List of courses taught in English at ENSC

Some courses are taught in English with documents in English (100% English) and others are taught in French with documents in English available and examination in English allowed (50% English).

First semester: September -January

- ENSC_S1-1: Basics of artificial intelligence, 3 ECTS, 100%English
  Content: Introduction to A.I., Min-Max algorithm, general problem solving, graph search, Dijkstra, A*, genetic algorithms, constraint satisfaction problems, basics of robotics
  Prerequisite: Advanced programming
- ENSC_S1-2: Human robot interactions, 3 ECTS, 50% English
  Content: Introduction to cobotics, examples of collaborative robots, exoskeletons, safety issues, practice with UR3 robotic arm and NAO robot.
  Prerequisite: Advanced programming
- ENSC_S1-3: Planning 3 ECTS, 100% English
  Content: Main algorithms and methods for action planning, path planning, motion planning in robotics. Main tools: graph search, A*, PDDL.
  Prerequisite: Advanced programming
- ENSC_S1-4: Project in Cognitive Engineering 15 ECTS, 100% English
  Under the responsibility of an academic supervisor, the student works on a project in the field of cognitive engineering. For example, participate to an experiment with robots and humans or implement machine learning techniques.
  Prerequisite: Bachelor with scientific background
- ENSC_S1-5: Cognitive Engineering and Human System Interaction 3 ECTS, 50% English
  Content: Understand human limitations and capabilities (both physiological and cognitive) and take them into account in IHS design. The case of aeronautics. Key words:
- Human limits and capabilities
- Cognitive Resource Management (CRM)
- Perception, information TTT, decision-making, human error, stress, learning, motivation
- Human-System Interaction
- UX & Human Factors
- Disruptive innovation
  Prerequisite: Bachelor with scientific background
- ENSC S1-6: Human systems interface 3 ECTS, 50% English
  Content: Human centered design of interfaces, analysis of interfaces, ergonomics
  Prerequisite: basics of cognitive science

Other courses: All courses of the specialization in Robotics or from the Masters of Science in Cognitive Engineering can be selected.

Depending on places and organizational constraints, some courses can also be taken in other Bordeaux INP engineering schools (agreement needed by international coordinator from that engineering school).

Second semester: January/February - July

- ENSC_S2-1: Machine Learning, 3 ECTS, 50% English
  Content: Supervised and unsupervised learning, neural networks, multi-layer perceptron, CNN, practice with Google Colaboratory platform
  Prerequisite: Advanced programming
- ENSC S2-2: Individual software engineering project, 5 ECTS, 100% English
  Content: End-to-end project in computer science, from the specifications (by the student) and project management to implementation (in the programming language chosen by the student) and tests, under the supervision of a professor.
  Prerequisite: Advanced programming
- ENSC_Internship, 30 ECTS, 5 to 6 months internship in a Bordeaux university laboratory. Please contact the direction of the laboratory for internship availability.

Fill in the application form (annex 7) and send it with CV to international@ensc.fr

Annex 7: Application form

BORDEAUX INP Ensc

Taylor made courses selection application form

	Last name	First name	Date of Birth	Nationality	Sex
Student					

English level: French level:

	University name	Faculty / department	Country	Existing partnership Y/N	Contact person
Sending institution					

Study programme		
Semester	Name of courses	European credits

Date :   Signature :

Send application form + CV to international@ensc.fr