ENSTA Bretagne

TRAINING PROGRAM

2019 > 2022

You will find all the information on our training programs in this leaflet. Each semester is composed of projects and lessons organized into Course Units (or Unités d'Enseignements / UE in French).
The first two semesters are common to all students, whereas the following semesters are different according to the options you choose to further your studies (9 possible choices).

YEAR 1 (BAC+3)

SEPTEMBER TO DECEMBER	JANUARY	JANUARY
SEMESTER 1	INTERNSHIP (4 WEEKS)	SEMESTER 2

YEAR 2 (BAC+4)

SEPTEMBER TO DECEMBER	DECEMBER TO APRIL	FROM MAY	FROM JUNE
SEMESTER 3	SHORT SEMESTER 4*	INTERNSHIP (4 À 5 MONTHS)	
	OR LONG SEMESTRE 4*		INTERNSHIP (3 à 4 months)

YEAR 3 (BAC+5)

SEPTEMBER TO FEBRUARY	FROM MARCH
SEMESTER 5	SEMESTER 6 = END OF STUDIES INTERNSHIP (5 to 6 months)

*The students can choose from 2 different options for Semester 4. If hethey wants to validate histheir international "quitus" during histheir 2nd year internship, hethey can finish histheir semester earlier. The Course Units (CUs) specific to a long Semester 4 are followed by an asterisk in the following tables.

CORE CURRICULUM

Course Units = Unités d'Enseignement (UE)

Semester 1	Semester 2
CU SYSTEMS MODELING (10 ECTS)	**CU SYSTEMS MODELING** (8 ECTS)
Mathematics for Engineers	Probability and Statistics
Introduction to Programming	Informatics
Introduction to MATLAB	Partial Differential Equations and Wave Propagation
Analysis of Spatial Data	Signal Processing 2
Signal Processing 1	Data Bases
Continuum Mechanics	Incompressible Fluid Mechanics
CU SCIENCES AND TECHNOLOGIES (10 ECTS)	**CU SCIENCES AND TECHNOLOGIES** (8 ECTS)
Technological Analysis	Manufacturing Processes
Computer Aided Design	Materials
Introduction to Systems Engineering	Mechanics of Deformable Bodies
Mechanics of Rigid Bodies	Experimental Mechanics
Sensors	Interfaces between Digital and Analog
Automatics 1	Sensor-Actuator Loop
Introduction to Digital Systems	Electrical Engineering

Semester 1 (10 ECTS)	Semester 2 (8 ECTS)	Semester 3 (5 ECTS)	Semester 4	Semester 5
CU HUMAN AND SOCIAL SCIENCES, SPORT AND LANGUAGE LEARNING				
LL 1 English	LL 1 English	LL 1 English	LL 1 English	Choice of LL1/LL2
LL2 optional	LL2 optional	LL2 optional	LL2 optional	Sport
Sport	Sport	Sport	Sport	Choice of Cultural Awareness Workshops
The Engineer and Society 1	The Engineer and Society 2	Financial Management	Company Activity	Leadership
Internship Preparation	Big Challenge		Optional Modules	
Personal Development 1	Personal Development and Society 2			
	Marketing and Human Resources			

These courses are or can be taught in English. All students may take their exams in English.

SPECIALIZATION

HYDROGRAPHY-OCEANOGRAPHY

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS FOR HYDROGRAPHY (9 ECTS)	**CU GEOMATICS** (3,5 ECTS)	**CU CARTOGRAPHY AND UNDERWATER NAVIGATION**
• Applied Mathematics • Linear Optimization • Estimation • Least Squares Method • Introduction to Hydrography • Bathymetry	• Kalman Filter • Geographic Data Management • Spatial Interpolation	• Cartography • Law of the Sea • Underwater Navigation
CU GEOSCIENCES (7,5 ECTS)	**CU OCEANOGRAPHY AND MARINE GEOPHYSICS** (5 ECTS)	**CU REMOTE SENSING AND MODELING**
• Geology • Meteorology • Tides • Geodesy • Positioning Technology	• Descriptive Physical Oceanography • Marine Geophysics • Geophysical Fluid Dynamics • Sub-Bottom Profilers	• Remote Sensing • Coastal Ocean Modeling
	CU HYDROGRAPHIC DATA PROCESSING AND ANALYSIS (3,5 ECTS)	**CU PROFILE**
	• Bathymetric Data Processing • Introduction to Geostatistics • Hydrographic Project Management	• Specific lessons according to profile • Hydrodynamics • ADCP : Acoustic Doppler Current Profiler

OBSERVATION SYSTEMS AND ARTIFICIAL INTELLIGENCE

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS (7 ECTS)	**CU OBSERVATION SYSTEMS** (6 ECTS)	**CU ARTIFICIAL INTELLIGENCE**
• Applied Mathematics • Linear Optimization • Operational Research • Localization by Kalman Filtering	• Machine Learning and Statistical Methods • Channel Access Electronics • Waves and Environment	• Machine learning (classification) • Machine learning & data sciences • Embedded Artificial Intelligence • Signals and Images 2
CU INFORMATICS AND NETWORKS (8 ECTS)	**CU INFORMATION PROCESSING** (4,5 ECTS)	**CU INTELLIGENT SYSTEMS**
• C/OS Programming • Exploitation Systems (OS) • JAVA Advanced Programming • Telecommunications	• Software Design • Signal and Image Processing 1	• Visual Servoing • Robust control • Electronic Systems Technology
	CU SPECIFIC TO LONG SEMESTER*	**CU OBSERVATION SYSTEMS**
	• Measures and Acquisitions	• Sensing and Observation Systems • EM & GE Detection • Advanced Systems Engineering

AUTONOMOUS ROBOTICS

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS (7 ECTS)	**CU INFORMATICS & ROBOTICS** (6 ECTS)	**CU INTELLIGENCE**
• Applied Mathematics • Linear Optimization • Operational Research • C++ Language	• Interval Computation • Middleware • Embedded Linux • 3D Vision	• Machine learning (classification) • Deep learning • Embedded Artificial Intelligence • Initiation to Research
CU LOCALIZATION (8 ECTS)	**CU EXPLORATION** (4,5 ECTS)	**CU AUTONOMY**
• Introduction to Robotics • Inertial units • Kalman Filtering • Networks	• Practical Robotics • Mobile Robot Control • Mobile Robot Simulation	• Visual Servoing • Robust Control • Systems Engineering
	CU SPECIFIC TO LONG SEMESTER*	**CU ROBOTICS AND INDUSTRY**
	• Robotic Challenge	• Execution and Competition • Robotic Architecture • Industry

SECURITY AND DIGITAL SYSTEMS

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS (7 ECTS)	**CU SYSTEM SECURITY** (6 ECTS)	**CU INFORMATION PROCESSING AND SECURITY**
• Applied Mathematics • Linear Optimization • Operational Research	• Information Processing and Protection • Component Security • Security and Supervision	• Machine learning (classification) • AI and Security • Security and Networks
CU INFORMATICS AND NETWORKS (8 ECTS)	**CU SYSTEMS ARCHITECTURE** (4,5 ECTS)	**CU SYSTEMS MODELING**
• C/OS Programming • Exploitation System (OS) • JAVA Advanced Programming • Networks	• Computer Architecture **Software Engineering Profile:** • Software Design • Compilation **Telecommunications Profile:** • Telecommunications 2 • Channel Access Electronics	• Modeling and Simulation • Trustworthy Environments • Advanced Systems Engineering • Choice of MOOCs and Lectures
	CU SPECIFIC TO LONG SEMESTER*	**SOFTWARE ARCHITECTURE MODELING AND SECURITY**
	• Enbedded Operating System (OS)	**Software Engineering Profile:** • Software Architecture Security and Attack • Software and Systems Modeling and Metamodeling • Verification and Validation **Telecommunications Profile:** • Radiocommunication • Electronic System Technology • SoPC : System On Programmable Chip

OFFSHORE AND NAVAL ARCHITECTURE

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS FOR MECHANICS (9 ECTS)	**CU CORE SUBJECTS** (4 ECTS)	**CU THEORY AND PRACTICE**
• Applied Mathematics • Mechanics of Materials • Finite Elements Method	• Composites • Plates, Shells and Beams 1 • Vibrations	• Offshore and Naval Platforms • Ship design Loop
CU BASICS IN NAVAL ARCHITECTURE (8 ECTS)	**CU OFFSHORE AND NAVAL ARCHITECTURE** (5 ECTS)	**CU CORE SUBJECTS FOR OFFSHORE AND NAVAL ARCHITECTURE**
• Mechanical Engineering • Fluid Dynamics for Incompressible Flows • Ship stability + Naval Basics	• Introduction to Ship Hydrodynamics • Finite Volume Method, Geometrical nonlinearity	• Naval Hydrodynamics • Naval Structures
	CU SPECIFIC TO LONG SEMESTER*	**CU PROFILES**
	• Composites 2, Shells and Beams 2 • Motion Equations	**Offshore Platform Design Profile (CPO)** • Offshore Platform Design • Issues in Offshore Engineering **Advanced Naval Structures Profile (SNA)** • Advanced Naval Structures • Issues with Structures/Materials in Marine Engineering **Advanced Naval Hydrodynamics Profile (HNA)** • Advanced Naval Hydrodynamics • Sailboat Design Loop

PYROTECHNIC SYSTEMS

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS FOR MECHANICS (9 ECTS)	**CU CORE SUBJECTS** (4 ECTS)	**CU PYROTECHNIC COMPONENTS**
• Applied Mathematics • Mechanics of Materials • Finite Elements Method	• Composites Materials 1 • Plates, Shells and Beams 1 • Vibrations	• Missiles and Ballistics • Self-Propulsion • Pyrotechnic Safety
CU BASICS IN PYROTECHNIC ENGINEERING (10 ECTS)	**CU PYROTECHNIC SYSTEMS** (5 ECTS)	**CU SHOCKS AND DETONATIONS**
• Mechanical Engineering • Incompressible Fluid Mechanics • Thermics/Thermodynamics/Thermochemistry	• Compressible Flows • Propulsion	• Shocks in Condensed Matter • Detonations • Dimensioning of Pyrotechnic Structures
	CU SPECIFIC TO LONG SEMESTER*	**CU COMBUSTION**
	• Composites Materials 2, Shells and Beams 2 • Motion Equations	• Laminar Combustion • Thermochemistry • Initiation Systems

VEHICLE ARCHITECTURE

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS FOR MECHANICS (9 ECTS)	**CU CORE SUBJECTS** (4 ECTS)	**CU VEHICLE ARCHITECTURE**
• Applied Mathematics • Mechanics of Materials • Finite Elements Method	• Composites Materials 1 • Plates, Shells and Beams 1 • Vibrations	• Vehicle Architecture • Systems Engineering • Digital Models
CU MECHANICAL ENGINEERING AND HEAT ENGINES (8 ECTS)	**VEHICLE ARCHITECTURE** (5 ECTS)	**CU POWERTRAINS**
• Mechanical Engineering • Power Transmission Systems 1 • Thermics/Thermodynamics/ Thermomechanics	• Vehicle Dynamics • Electric Vehicles	• Heat Engines • Power Transmission 2 • Hybridization
	CU SPECIFIC TO LONG SEMESTER*	**MATERIALS AND STRUCTURES**
	• Composites Materials 2, Shells and Beams 2 • Motion Equations	• Finite Elements and Non-Linearity • Thermodynamics and Behavior Laws • Fatigue

ADVANCED MODELING OF MATERIALS AND STRUCTURES

Semester 3	Semester 4	Semester 5
CU CORE SUBJECTS FOR MECHANICS (9 ECTS)	**CU CORE SUBJECTS** (4 ECTS)	**CU ADVANCED MODELING OF MATERIALS**
• Applied Mathematics • Mechanics of Materials • Finite Elements Method	• Composites Materials 1 • Plates, Shells and Beams 1 • Vibrations	• Elastomers and Composite Materials • Multi-Scale Approches • Fatigue and Experimental Techniques
CU MECHANICAL ENGINEERING AND HEAT ENGINES (8 ECTS)	**CU ADVANCED MODELING OF MATERIALS AND STRUCTURES** (5 ECTS)	**CU SPECIFIC APPLIED FORCES**
• Mechanical Engineering • Power Transmission Systems 1 • Thermics/Thermodynamics/Themomechanics	• Introduction to Advanced Modeling of Materials and Structures • Optimization	• Explicit Dynamics • Stability and Finite strain theory
	CU SPECIFIC TO LONG SEMESTER*	**CU MODELING OF MATERIALS AND STRUCTURES**
	• Composites Materials 2, Shells and Beams 2 • Motion Equations	• Non linear Finite Elements • Thermodynamics and Constitutive Equations

→ SPECIALIZATION

ENGINEERING AND BUSINESS SCIENCE

Semester 3	Semester 4	Semester 5

These in-depth studies take place in Semester 5. They are proposed in addition to the courses given in Semesters 3 and 4 and in one of the 8 other in-depth study paths.

CU LEGAL, POLITICAL AND ECONOMIC ENVIRONMENTS

- Economics (international, defense, industrial)
- Law (European and institutional, intellectual property, contract law)
- Strategic Monitoring
- Social Responsibility of Businesses

CU PROJECT MANAGEMENT, INNOVATION MANAGEMENT AND BUSINESS ENGINEERING

- Project Management (abroad, supply chain)
- Management Information Systems
- Production Management (lean management, quality management, team leadership, management of intangible assets
- Serious Game on Business Engineering

CU ENVIRONMENT AND COMPETITION

- Marketing : Ccommercial Ddevelopment, Ccrisis Ccommunication
- Economic Intelligence
- International Negotiation Tools
- Technology Transfers



→ THE PROJECTS

SEMESTER 1/Bibliography

The bibliographic study is approached as a research exercise: reading then synthesis of the technical and scientific documents.

The objectives are to learn how to gather information, work in a team, successfully complete work within pre-fixed deadlines and write a formatted bibliographic synthesis. The students show proof of initiative, curiosity and autonomy.

SEMESTER 2/ Systems Discovery and Analysis

Semester 2 is composed of 3 projects enabling the first courses to be put into practice.

These 3 projects (the "Informatics" Project, the "Big Challenge" Project and the "Systems Discovery" Project) enable the students to develop their abilities to problematize, comprehend complexity in various fields as well as put their knowledge into practice to answer the issues raised.

SEMESTER 3/ Field Application Project

This Course Unit is composed of project leadership (leading a project...) and project management (multi-cultural aspects, diversity...), systems engineering courses and a scientific and technical pre-project linked to the chosen training profile.

It comprises the 3rd step in the series of projects which aims to increase autonomy and the active acquisition of knowledge throughout the training.

SEMESTER 4/ The Enhanced Focus Project

This enables future engineers to deal with an industrial issue proposed by a business in the field of mechanics, information technologies, or hydrography. Grouped into small teams (2 to 5 students), the future engineers are required to apply a project management approach to satisfy the industrial objectives defined by the project initiator.

This major project enables the students to apply their scientific and technological knowledge, make contacts, establish the scope of the subject and the important technical choices to respect the deadlines. In some cases, their work concludes with the design of a demonstrator. A second project is proposed to students who opt for the long semester with a choice of either an introduction to research or entrepreneurship.

SEMESTER 5/ Enhanced Focus Systems Project

This enables students to work on concrete subjects comparable with those that they will meetcarry out in their future career.

In order to confront this real industrial issue, in relation with their in-depth study path, the student engineers are called upon to review and apply their knowledge as well as demonstrate their initiative. This is not an academic exercise with a single solution. Within their teams, the students have to envisage different scenarios and choose the answer that seems to them to be the most suitable for the objectives and constraints imposed, in the time allowed.

The courses and ECTS listed in this document are for information purposes only. They are liable to change in line with company expectations.
These developments are part of the continuous improvement plan. ENSTA Bretagne has received the ISO 9001 accreditation for all its activities.