ISEN

ALL IS DIGITAL!

OUEST

yncréa

ENGLISH COURSE CATALOGUE 2023-2024

Energy

Internet of Things

Robotics - Drones

Software Engineering

Electrical Engineering

Embedded Systems

Marine Technologies

Commercial Engineering

BREST - CAEN - NANTES - PARIS - RENNES

ENGINEERING SCHOOL

SUMMARY

ISEN

ALL IS DIGITAL!

OUEST

yncréa

ENGINEERING SCHOOL

#WHOAREWE?

ISEN Yncréa Ouest is an engineering school with 5 campuses located in Brest, Caen, Nantes, Paris and Rennes.

As a French 'Grande École' Engineering School, we provide high level scientific training delivered by faculty with both research and professional expertise.

International students join their French counterparts in small-sized class groups which enhance student-teacher interaction, and enable students to gain valuable cross-cultural skills as they work together in mixed nationality teams.

- More than 1400 students (2022 – 2023)
- 29000 alumni in France and across the world

Students can choose to study in Brest or Nantes depending on their choice of major.

Travelling to ISEN Ouest

International airports and high speed trains connect the four cities nationally and internationally.

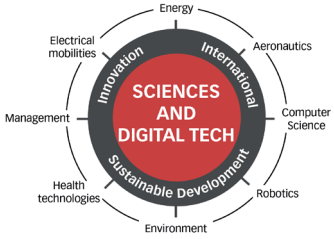
#CONTACTS

Gaëlle MOAL
Director of International Relations
gaelle.moal@isen-ouest.yncrea.fr

Susan GIBBS
Head of International Relations
susan.gibbs@isen-ouest.yncrea.fr

#SCIENCESANDDIGITALTECH

Because digital technologies are everywhere, ISEN trains engineers to meet the needs of companies in a wide range of sectors.



#SOCIAL

Life at ISEN Ouest

ISEN Ouest enjoys a very dynamic student life with over 30 clubs: "Junior Entreprise", music, robotics, electronics, sports clubs, etc, and has a very active Students' Union organizing a wide variety of activities.

ISEN halls of residence

Studio apartments are available on campus or nearby. Each studio has good transport connections to the city center. Incoming students receive help from our international office to find accommodation.

Restaurants and cafeterias

Really close to ISEN, several university restaurants are open for lunch and dinner: self-service restaurants with different choices of menu. Cafeterias are available on each campus or nearby.

#ADMISSIONS

Applications open to students from ISEN's partner universities.

Deadline:

Autumn: May 30 / Spring: October 30

Level B2 in English required

OVERVIEW OF ACADEMIC COURSE OFFER IN ENGLISH*

Major	Campus	Autumn Name of Class	ECTS		Spring Name of Class	ECTS
Robotics Drone	Brest	Introduction to aerial drones	1,5		Middleware & computer architecture of autonomous robots	3
		Computer language for robotics (C++)	3		Robot kinematics	3
					Actuators	1,5
		Introduction to mechanics of materials and prototyping	1,5		Communication Protocols	3
Software Engineering	Nantes	Introduction of Computer Language Theory	3			
		Artifical Intelligence	3			
		Operations Research	3			
Electrical Engineering	Brest	Advanced Electromechanical Transformation	3		Advanced Static Converters	3
		Case Studies and Industrial conferences	3		Advanced Static Converters (practical)	3
		Electrical Machine Control	3			
Internet of Things	Nantes	Laboratory in IoT -based LoRa Deployment (project)	3			
		Advanced electronics for Telecommunications	3			
		IOT for Cybersecurity	3			
		Cloud and Virtualisation	3			
		Internet of Multimedia Things	3			
Embedded Systems	Brest	Ocean Observatories	3			
		Advanced Static Converters	3			
		Smart Grids	3			
		Renewable Energies	3			
		Electrical Machines and Drives	3			

*Subject to change.

Energy	Brest	Energy market: Issues and challenges in the energy industry	1,5			
		Practical exercises	1,5			
Major	**Campus**	**Autumn** Name of Class	**ECTS**		**Spring** Name of Class	**ECTS**
Marine Technologies	**Brest**				C++ for Robotics	3
					Underwater Acoustics & Optics: Fundamentals of Applied Ocean Acoustics Ocean Optics	 3 3
					Underwater Sensor Networks: Underwater Sensor Networks Observations	**1,5**
		Signal Processing: Wireless Communication in Maritime Systems	3		**Signal Processing:** Surface Navigation Systems Atypical Communication Systems Subsea Positioning	 3 3 3
		Embedded Systems: Ocean Sensors	3		**Embedded Systems:** Software Development for Embedded Systems	 3
					Applications: Digital Twins for the Energy Industry Multi Agent Systems Ocean Observatories	 3 1,5 3
Commercial Engineering	Brest	Marketing of Innovation	3			
		Corporate Social Responsibility	3			
		Comprehension of IT Sector	3			
		Advanced Information Systems Management	3			
		Contract Law in IT	3			
		B2B Marketing	3			
		Negotiation in a B to B context	3			
		Project Management	2,5			
		Competitive Strategy	3			

ISEN Academic Offer:
Technical Subjects: 12 ECTS
Technical Project (related to major): 10 ECTS
French and Intercultural Classes: 8 ECTS
TOTAL: 30 ECTS

ROBOTICS - DRONES

	Campus	Semester	N°hours	ECTS
Introduction to aerial drones	Brest	Spring (S8)	15h	1,5
Objectives: Introduction to aerial drones architecture, assembling and pilot				
Prerequisites: Basic knowledge of electronics and programming				
Programme: - Drones architecture - Flight principles of drones - Introduction to drones embedded systems - Basic practices in aerial drones pilot - Introduction to autonomous flight				
Computer language for robotics (C++)	Brest	Spring (S8)	30h	3
Objectives: Introduction to C++ language for application in robotics projects				
Prerequisites: Basic knowledge of programming				
Programme: - C++ Basics - Conditional Statements and Loops - Functions - Arrays and Pointers - Classes				
Introduction to mechanics of materials and prototyping	Brest	Spring (S8)	15h	1,5
Objectives: Introduction to solid mechanics to learn fundamental approaches for mechanical projects while considering notably additive production methods.				

Prerequisites:
Basic knowledge of statics and 3D CAD design

Programme:
- A fast prototyping method for engineering schools
- Equilibrium of a deformable body
- Average normal and shear stresses
- Deformations
- Mechanical properties of materials, the stress-strain diagram, stress-strain behaviour of ductile and brittle materials, strain energy.
- Introduction to Finite Element Analyses (FEA)
- Additive manufacturing best practices

Middleware & computer architecture of autonomous robots	Brest	Autumn (S9)	30h	3

Objectives:
- Acquire a general vision of middleware for robotics
- Be familiar with the ROS middleware and know how to use it for its main functionalities
- Understand robotic architectures

Prerequisites:
Basic knowledge of the LINUX system and C++ programming language

Programme:
- ROS basics
- ROS Topic (publisher, subscriber, and message)
- ROS Service (client, server, and message)
- ROS Action (client, server, and message)
- C++ classes in ROS

Robot kinematics	Brest	Autumn (S9)	30h	3

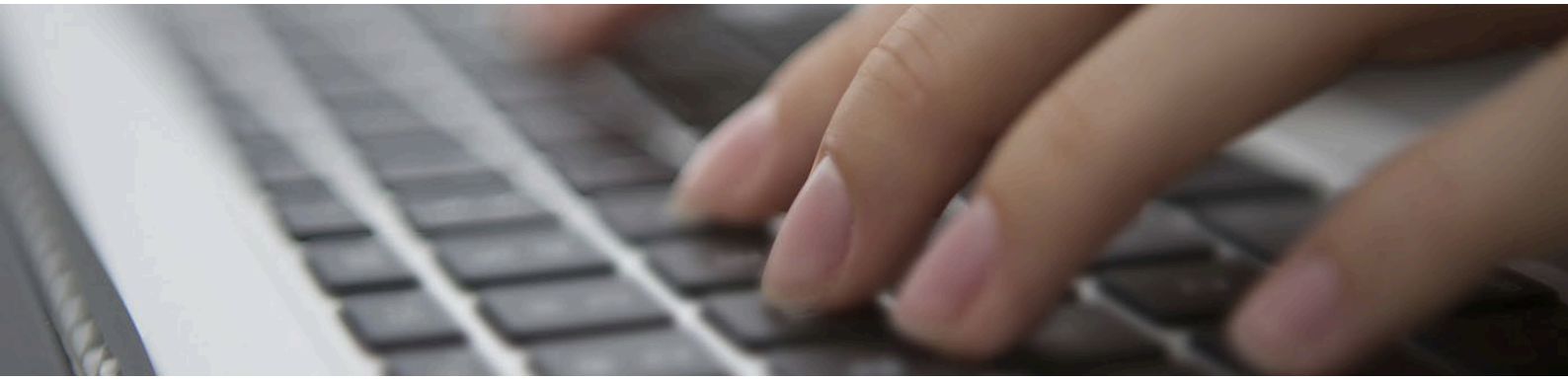
Objectives:
Introduce the fundamental concepts that allow the modeling of serial robotic arms

Prerequisites:
- Basic notions of kinematics
- Matrix calculation

Programme:
- Introduction
- Robot geometries and industrial classification
- The architecture of manipulator robots: series and parallel structures
- Types of kinematic joints
- Spatial descriptions
- Homogeneous transformations
- Denavit-Hartenberg convention
- Euler angles
- Inverse manipulator kinematics

Communication Protocols	Brest	Autumn (S9)	30h	3
Objectives: Reading and writing in binary, hexadecimal, programming in C/C++/Python, using Linux.				
Prerequisites: Discover and implement different communication protocols often used in robotics (wired or wireless, high or low level).				
Programme: - UART TTL - I2C - TCP UDP - Xbee				
Actuators	Brest	Autumn (S9)	15h	1,5
Objectives: - Understanding, modelling and controlling serial manipulators.				
Prerequisites: Control theory and basic programming				
Programme: - Overview of different types of actuators - Actuators modeling - Strategies for controlling actuators				

SOFTWARE ENGINEERING



Title	Campus	Semester	N° hours	ECTS
Introduction of Computer Language Theory	Nantes	Autumn (S9)	30h	3

Objectives:
The objective of the course is to present the notions of formal languages, lexical and syntax analysis, and semantics that are essential for the construction of compilers.

Prerequisites:
Knowledge about algorithms and programming languages.

Programme:
- Grammars
-Finite State Automata
-Regular languages
-Context-free grammars
-Pushdown automata (PDA)
-Lexical analysis (scan)
-Syntactic analysis (parse)

Artificial Intelligence	Nantes	Autumn (S9)	30h	3

Objectives:
- Understand basics of neural networks and machine learning solution approach
- Program, test and fine tune those basics in Python

Prerequisites:
- Python programming
- Mathematics for engineering schools

Programme:
- Neural network theory (perceptron and multi-layers perceptron)
- Gradient and stochastic gradient descent algorithms
- Study of hyperparameters selection for machine learning
- Python programming for neural networks

Operations Research	Nantes	Autumn (S9)	30h	3

Objectives:

This course deals first with integer linear modelling. After reviewing basic of optimization models, we will especially detail the branch and bound method that is applied to optimally solve integer linear programs. The second main part of this course concerns classical scheduling optimization models solved in industry. We will review and apply some well-known heuristics and meta-heuristics. The last part of the course addresses flows and multicommodity flows models. After discussing key mathematical proofs related to flows modelling in graphs, the algorithms of Ford-Fulkerson and Busacker-and-Gowen are implemented and tested.

Prerequisites:

- Basics of algorithm design in computer science
- Introduction to graph theory
- Basics of programming (C, Java or Python)

Programme:

- Integer linear modelling
- Reviewing basics of optimization models
- Classical scheduling optimization models solved in industry
- Application of heuristics and meta-heuristics
- Flows and multicommodity flows models

ELECTRICAL ENGINEERING

Title	Campus	Semester	N° hours	ECTS
Advanced static converters	Brest	Spring (S8)	30h	3
Objectives: Give future engineers the necessary skills to model and define a control law for a static converter in order to provide it with a level of performance (static precision, stability, bandwidth, response time, harmonic spectrum, etc.).				
Prerequisites: Fundamentals of power electronics, regulation of linear systems, PWM, Matlab/simulink				
Programme: - Modeling of static transformers - Control of static transformers - Sizing of passive components used in power electronics				
Advanced static converters (practical)	Brest	Spring (S8)	30h	3
Objectives: Give future engineers practical experience in power electronics by allowing them to manipulate measuring material. These skills will be developed in a practical mini project				
Prerequisites: Classes on static converters				
Programme: - DC/DC converter - DC/AC converter with bi-controllable converters - AC/DC converter with bi-controllable converters - DC/DC converter with inductive storage - Photovoltaic panel converter association - Mini-project DC/AC transformer				

Advanced Electromechanical transformation	Brest	Autumn (S9)	30h	3
Objectives: Understand the different types of electrical machines and the different ways to model them				
Prerequisites: Classes on electromechanical transformation				
Programme: - Principles of electromechanical conversion - Synchronous Machines - Asynchronous Machines - Dynamic modelisation aiming to driving				
Case studies and industrial conferences	Brest	Autumn (S9)	30h	
Objectives: Provide a wider vision of the field of electrical engineering and in particular electric vehicles via applied case studies and industrial conferences				
Prerequisites: N/A				
Programme: - Case studies on sizing of power electronics systems in different mobility applications (automotive, aviation, naval etc) - Industrial conferences (Thales, SNCF etc)				
Electrical machine control (practical exercises)	Brest	Autumn (S9)	30h	3
Objectives: Provide future engineers with experimental training in electrical engineering so that they can implement a complete energy conversion chain.				
Prerequisites: Classes on electromechanical transformation				
Programme: - Torque control of a synchronous machine - Torque control of an asynchronous machine - Control of a sensorless synchronous machine - Inverter rectifier with sinusoidal current absorption - Multicell inverter rectifier - Energy storage using super capacitors - Industrial drives - Synthesis				

INTERNET OF THINGS

Title	Campus	Semester	N° hours	ECTS
Laboratory in IoT -based LoRa Deployment (project)	Nantes	Autumn (S9)	30h	3

Objectives:

- Understand the ecosystem of IoT
- Characterize LPWAN (Low Power Wide Area Network) technologies
- Understand the radio LoRa modulation
- Dimension and design several solutions based on LoRa gateways
- Program data management with MQTT protocol and data visualization

Prerequisites:

Basis of digital electronics. Some basic knowledge on Linux administration or embedded Linux.

Programme:

The topics covered in this class are:

Introduction to IoT:

- Introduction to IoT ecosystem
- overview of the enabling technologies behind IoT
- getting familiar with programming on raspberry-pi

Definition of LoRa and LoRaWAN:

- definition of LPWAN (Low Power Wide Area Network)
- demystifying LoRa and LaRaWAN
- description de LoRa modulation with Matlab

Solution deployment:

- deploy LoRa based IoT solution using Kerlink Gateway and industrial sensors
- deploy LoRa based IoT solution using IMST Gateway
- deploy low-cost LoRa based IoT solution using pycom sensor and gateway
- use of TTN, MQTT, Cayenne, VM for solution enhancement

Advanced Electronics for Telecommunications	Nantes	Autumn (S9)	30h	3

Objectives:
At the end of the course, the student should be able to:
- Understand the role of electronic components used for radio receivers,
- Understand the system on programmable chip contribution for telecommunications,
- Create, package, customize IP and design and profile system performance,
- Design of some functional blocks used for new radio receiver systems.

Prerequisites:
Basis of digital electronics. Solid understanding of the design with FPGAs. Some knowledge on VHDL and C/C++ languages.

Programme:
The topics covered in this class are:
SoPC design:

- Xilinx SoPC hardware and software environments
- use of Vivado and Vivado HLS suite for fast IP design
- advanced use of HLS directives

The laboratories should include the design of functional blocks used for new radio receiver systems. In past years, labs have included the design of direct digital synthesizer (DDS), digital filters, channel coding. Applications are drawn broadly from IEEE standardization committees.

IOT Cybersecurity	Nantes	Autumn (S9)	30h	3

Objectives:
The "Cybersecurity" (Cyber) module provides students with the necessary skills related to cryptography and the security of exchanges on the Internet. First, an introduction to cryptography allows students to grasp the basics of cryptography applied to communication services on digital networks (i.e. Internet). Then, through the various practical works, the students will be able to design and implement secure digital exchanges, in particular by installing security solutions in connection with public key infrastructures. Finally, a set of courses in the form of conferences is given to gain skills in: general knowledge of the world of cybersecurity, understanding of the risks and technical modus operandi, understanding of the means of protection and more generally discovery of the project mode in cybersecurity.
The student will be able to analyze and evaluate the encryption algorithms used in networks to qualify their level of vulnerability, and at the same time be able to propose technical solutions to implement security protocols in networks in order to overcome vulnerabilities. security, optimize networks and ensure optimal security.

Prerequisites:
Linux Administration and Basic Linux Knowledge.
Basic knowledge of computer networks. OSI model.
Basic Windows knowledge. Cisco CCNA1 & CCNA2. C development knowledge

Programme:
- Basic concepts of cryptography and its application in Internet protocols
- Discovery of the different aspects of cybersecurity
- Exploration of the different stages of a cyberattack and protection solutions
- Transport Layer Security (TLS)
- Virtual Private Networks (VPN)
- Public key infrastructure and security (confidentiality and authentication) of emails.
- Security (and security vulnerabilities) on 802.11 wireless networks (WiFi)

Cloud and Virtualisation	Brest	Autumn (S9)	30h	3

Objectives:
The “Networks and Virtualization” module (ResVir) gives students the technical elements necessary to have skills related to the mastery of tools necessary for the configuration and administration of computer networks. In addition to these basic skills, two advanced notions of networks are covered. The first is to know how a multicast network works based on the use of advanced tools (VLC, wireshark, GNS3) and to understand the concepts relating to VPNs used by access providers. The second, more advanced, deals with network virtualization: students understand the challenges of the cloud, grasp the vocabulary inherent in network virtualization, have an overview of existing virtualization solutions and analyze their differences, install tools administration and orchestration complex (openstack, ansible), set up a virtualization solution within the school network and deploy a flexible and remotely accessible network of virtual machines. Part of the virtual network infrastructure developed is used in the IYOGE-S9-SF9-ResServ-M7 module to set up a Voice over IP (VoIP) service on a virtualized infrastructure.

Prerequisites:
Linux administration, SSH server, basic knowledge of computer networks. OSI model.

Programme
- Implementation of a multicast network and study of operation
- Implementation of a model allowing the routing of IP packets through a VPN
- Definition of virtualization, cloud, knowledge of the technical elements of virtualization and the cloud, understanding the challenges of the cloud
- Use OpenStack cloud
- Deploy a small OpenStack cloud
- Use of ansible and git, system administration

Internet of Multimedia Things	Nantes	Autumn (S9)	30h	3

Objectives:

Through the lessons provided in this module, students will have skills in two areas. First, they will understand the challenges of data compression, which is very useful in the field of IoT. They will be able to analyze the interest of each processing block used in data compression chains: transform, entropy coding, quantification, estimation, prediction and motion compensation. They will understand the challenges of standardization, changes in standards and the performance in terms of throughput and distortion expected in each standard. In addition, they will be able to set up several video coding chains by simulation in accordance with the new standards: MPEG, H264, HEVC and VVC and thus carry out a comparative study between these different standards.

The second part concerns the application of artificial intelligence algorithms for IoMT nodes. Students will understand the value of near-sensor computing as opposed to cloud computing. Then, through a simple scenario, they will program a convolutional neural network for face recognition on a GPU. Thus, they will control the energy consumed by the node, because they the node does not transmit the face but an index representing the face.

Prerequisites:

Programming in C/C++/Python, notions of transforms in mathematics, the basics of image processing

Programme:

Multimedia data compression

- Study of an image and video compression chain
- Implementation by simulating image compression
- Implementation and performance comparisons of video compression solutions of 4 standards: MPEG, H264, HEVC, VVC.

IoMT node for face recognition

- Introduction to GPUs and CUDA programming
- Inference for object detection
- Inference for face recognition
- Written assessment

EMBEDDED SYSTEMS

Title	Campus	Semester	N° hours	ECTS
Advanced static converters	Brest	Autumn (S9)	30h	3

Objectives:

The marine observatories course gives an overview about different types of sensors, instruments, platforms and on-going projects that are providing seawater information in order to study the oceans. In the past, human intervention was necessary to take measurements, but nowadays, cabled observatories, buoys, drifters or unmanned vehicles are performing more cost-efficient data samples. During the course the students will perform a work in group task for the design of a cabled observatory that will be presented at the end of the course. During lectures the tools and required information will be given.

Prerequisites:

Fundamentals of power electronics, regulation of linear systels, MLI, Matlab/simulink

Programme:

- Marine observatories
- Sensors and instruments
- Buoys, USV and AUV
- Group task for design

MARINE TECHNOLOGIES

Title	Campus	Semester	N° hours	ECTS
C++ for Robotics	Brest	Spring (S8)	30h	3

Objectives:
Introduction to C++ language for application in robotics projects

Prerequisites:
Basic knowledge about programming

Programme:
- C++ basics
- Conditional statements and loops
- C++ classes
- Functions
- Arrays and Pointers
- Micro projects

Underwater Acoustics and Optics

Title	Campus	Semester	N° hours	ECTS
Fundamentals of Applied Ocean Acoustics	Brest	Spring (S8)	30h	3

Objectives:
- Learn the variety of underwater sounds
- Understand sound pressure
- Understand how sound propagation is affected by the marine environment
- Learn the units

Prerequisites:
Basics of signal processing, Python and scientific libraries (numpy, matplotlib, etc),Matlab, EM Physics and wave equations.Corequisites: Fundamentals of applied oceanography

Programme:
- Physical water acoustics
- Definitions of measurements to describe underwater soundscapes
- Introductions to regulations
- How to quantify impact of underwater noise

Ocean Optics	Brest	Spring (S8)	30h	3

Objectives:
Successful students will:

- Understand the light propagation in seawater and be able to simulate the optical properties of ocean waters depending on their chemical and biological composition.
- Know the Essential Ocean Variables which may be studied with optical sensors and be able to build an optical setup to measure some of them.
- Understand the specificities of underwater imaging and be able to write an algorithm to correct some aberrations due to seawater.

Prerequisites:
Maxwell equations. Geometric optics. Basics of image processing. Python programming language.

Programme:
- Electromagnetism in seawater
- Optical properties of seawater
- Effects of dissolved matter, suspended molecules and phytoplankton in seawater
- Essential Ocean Variables measured by optical methods. Optics based sensors for oceanography.
- Fluorescence sensor. Quinine. Chlorophyll a. O2 (quenching).
- Optical salinity sensors
- Underwater imaging
- Image processing for color and turbidity corrections. Retinex, histogram equalizer and dehazing algorithms

Underwater Sensor Networks

Underwater Sensor Networks Observations	Brest	Spring (S8)	15h	1,5

Objectives:
At the end of the course the students will:
- know the sensing technology used in ocean sciences;
- know the critical aspects when designing an ocean observatory;
- know how to design an ocean observatory;
- know the MAC and routing protocols used in underwater sensor networks;
- know how to implement these protocols into a modem.

Prerequisites:
Basics of ISO/OSI protocol stack, Probability theory. Corequisites: Fundamentals of applied oceanography, Fundamental of Ocean Acoustics.

Programme:
- Marine observatories
- Definition and analysis of the networking protocols used in underwater acoustic networks
- Implementation of above mentioned protocols in an underwater acoustic model

Signal Processing				
Wireless Communication in Maritime Systems	Brest	Autumn (S9)	30h	3
Objectives: **Successful students will:** - Understand the wireless communication technologies for above surface and underwater data transmission.				
Prerequisites: Signal processing. Digital communication basics				
Programme: - Digital communications theory - Wireless communication channels - Maritime communication - Underwater acoustic modem				
Surface Navigation Systems	Brest	Spring (S10)	30h	3
Objectives: **Successful students will:** - Understand the light propagation in seawater and be able to simulate the optical properties of ocean waters depending on their chemical and biological composition. - Know the Essential Ocean Variables which may be studied with optical sensors and be able to build an optical setup to measure some of them.				
Prerequisites: Differential Calculus, Matrices, Probabilities, Signal Processing				
Programme: To be confirmed				
Atypical Communication Systems	Brest	Spring (S10)	30h	3
Objectives: Successful students will: - Understand the fundamentals of digital communication applied to different physical layers - Understand the role of diversity combining, equalization, noise cancelation, and coding - Know how to choose algorithms depending on the specifics of the physical layer - Experience implementing algorithm and evaluate performances - Provide critical thinking about technical choices				

Prerequisites:
Basics of signal processing, Matlab

Programme:
- Telecommunication platforms.
- Physical layers.
- Telecommunication algorithms.
- Hands-on implementation.

Subsea Positioning	Brest	Spring (S10)	30h	3

Objectives:
Successful students will:

- Acquire concepts and limitations of INS solutions.
- Understand the importance of subsea positioning and acoustic communication for underwater applications.
- Understand inertial mechanism in order to learn to think critically about the results of inertial real-time or post-processed data.
- Understand the advantages and drawbacks of different subsea positioning techniques.
- Be able to calibrate and plan the layout of production subsea positioning systems.
- Perform inertial and positioning data processing.

Prerequisites:
Basics of inertial navigation and Kalman Filtering, Basics of underwater acoustic propagation, Basics of subsea positioning

Programme:

- Accuracy limitation of INS systems and inertial data processing.
- Advantages and drawbacks of positioning technologies.
- Introduction to sparse-LBL.
- Calibration methods for a transponder.
- Examples of ROV, AUV positioning applications using real-life data.

Embedded Systems

Ocean Sensors	Brest	Autumn (S9)	30h	3

Objectives:

This course will present the electronic design techniques for in-situ instruments recording Essential Ocean Variables (EOV), focused on accurate sensor reading, low-power techniques with a conservative design philosophy.

Prerequisites:
Analog electronics design, Analog to Digital Conversion

Programme:
- Marine Environment Constraints
- Sensor and Calibration Theory
- Sensor Conditioning
- Lab experimentation

Software Development for Embedded Systems	Brest	Spring (S10)	30h	3

Objectives:

Successful students will:
- Know how to integrate ocean sensors in a static platform such as a buoy or observatory.
- Understand timestamping and proper data logging techniques.
- Safe data storage and transfer
- Real-Time systems

Prerequisites:
Embedded C programming, familiarity with STM32 microcontrollers and the STM32CubeIDE development environment.

Programme:
- Timestamping and data logging.
- Instrument interfaces.
- Introduction to FreeRTOS, and real-time concepts.
- DMA, I/O and memory management.

Applications

Digital Twins for Energy Industry	Brest	Spring (S10)	30h	3

Objectives:
To understand the concept of digital twin and its use (example marine renewable energies),

Prerequisites:
- notion of energy conversion
- systems modeling
- knowledge of python / matlab / simulink

Programme:
- Concepts and definitions of mechanical modeling for offshore wind turbine floating structures
- Anomaly detection and modeling.
- Digital twins architecture

Multi-Agent Systems	Brest	Spring (S10)	15h	1,5

Prerequisites:
Basic skills in object-oriented programming

Programme:
- Agent based modelling
- Geographical and environmental data

Ocean Observatories 2	Brest	Spring (S10)	30h	3

Objectives:

Successful students will:

- Understand the basic mechanical constraints applied to an oceanographic equipment.
- Learn several types of sealings and be able to propose a sealing for a specific purpose.
- Understand the basis of dimensioning an anode to protect a steel or aluminum immerged structure.
- Learn how to calculate the weight in water of solid or soft vessels, depending on immersion depth.

Prerequisites:

Ocean observatories 1 (S8). Basic knowledge on Mechanical CAD tools.

Programme:

- Ocean observatories 1 (S8). Basic knowledge on Mechanical CAD tools.
- Watertightness, corrosion and floatability.
- Design of a watertight vessel.

ENERGY

Title	Campus	Semester	N° hours	ECTS
Electrical Machine and Drives	Brest	Autumn (S9)	30h	3
Objectives: - Understand the operating principles of electric drives - Learn the characteristics, and be able to model an electromechanical conversion systems in steady state and transient behavior, and identify their operating mode.				
Prerequisites: Fundamental electricity and magnetism				
Programme: - Electromechanical conversion - Characteristics of industrial loads and their modelling - Electrical machines: steady state modelling and energy balance - Speed control and adjustable speed drives: dynamic and transient modelling - Sizing of an electric drive system - Industrial standards				
Smart Grids	Brest	Autumn (S9)	30h	3
Objectives: - Understand the architecture, operation, and issues in an electrical network with high penetration of renewables - Acquire skills in managing electrical energy in renewable energies context				
Prerequisites: Fundamental electricity, power electronics				

Programme:

Operation of an electricity network:

- Structure of transmission and distribution networks
- Organisation and technology of overhead/underground networks
- Other technical and economic characteristics

Challenges of electricity networks:

- Electricity and climate change
- Increasingly complex and decentralised management
- Presentation and characteristics of a smart grid
- Solutions and case studies

Renewable energies	Brest	Autumn (S9)/ Spring (S8)	30h	3

Objectives:

- Understand the principles of electrical energy production from renewable resources.
- Acquire the skills to design a hybrid energy production system.

Prerequisites:

Energy transformation

Programme:

- Introduction to renewable energy
- Wind energy: wind turbines
- Solar energy: photovoltaics
- Marine energy: Waves, tidal and marine currents
- Energy storage systems

Energy market: Issues and challenges in the energy industry	Brest	Autumn (S9) Spring (S8)	15h	1,5

Objectives:

- Understand the cross-cutting issues related to the energy industry
- Acquire a transversal vision of an industrial activity

Prerequisites:

- Geopolitics of energy
- Physical order of magnitude
- Climate and biodiversity
- Planetary resources

Programme:

Introduction

- History and types of energy used by human beings,
- Technologies, energy efficiency and orders of magnitude,
- Choice of an energy or industrial sector by the students (in connection with their career objectives if possible), split class in work group of 3-4 students.

Energy / climate - biodiversity issues

- Workshop “The Climate Fresk”,
- Feedback focused on energy and climate,
- Introduction to CO2 / Other Greenhouse Gas footprint,
- Group work: investigation and discussion on the ecological and climatic consequences of the chosen sector.

Economic and geopolitical issues

- Economy opportunities: the electricity market in Europe,
- Geopolitical issues: example with an oil & gas region,
- Group work: research on economic opportunities and geopolitical challenges in the chosen industry.

Planetary limits - Pressure on resources

- Introductions to planetary limits and raw material availability,
- Peak oil - energy return rate - known reserves and production forecasts,
- Group work: find documentation related to resource limits for the chosen sector.

Practical exercises	Brest	Spring (S8)/ Autumn S9	15h	

Objectives:

Give future engineers an experimental training in power electronics and electrical machines by enabling them to:

- Handle measurement equipment
- Discover electrical systems in practice
- Develop skills for the implementation and realization of a practical test benchs.

Prerequisites:

Electrical machines and dirves (S9) Power electronics (S8)

Programme:

- Getting started with DSpace
- Synchronous machines (Behn-Eschenburg diagram)
- Synchronous machine (grid synchronisation and energy management)
- Asynchronous machine (equivalent electrical scheme)
- Asynchronous machine (Motoring and generating modes)
- Brushless DC Machine
- Asynchronous machine (V/f control)
- Unitary power factor rectifier
- Characterisation of a solar panel

COMMERCIAL ENGINEERING

Title	Campus	Semester	N° hours	ECTS
Marketing of Innovation	Brest	Autumn (S9)	30h	3

Objectives:
- Plan a marketing campaign using innovative marketing platforms
- Explain the cycles of consumer adoption of innovations and the obstacles to accelerating the rate of adoption
- Identify the competitive advantages of successful innovative companies and the key success factors of top rated innovative products and services
- Evaluate the strengths and weaknesses of major business models in the workplace
- Explore the potential value in interaction and co-creation.

Prerequisites:
Marketing Fundamentals

Programme:
- The challenges of innovative marketing platforms,
- The theory of adoption of innovations and factors that accelerate the rates of adoption,
- The nature of innovation-based competitive advantages in the marketplace,
- The different alternatives in terms of business models for innovative products and services,
- The importance of pricing strategies when launching new products and services,
- The dynamics of innovative industries.

Title	Campus	Semester	N° hours	ECTS
Corporate Social Responsibility	Brest	Autumn (S9)	30h	3

Objectives:
This module supports the learning outcomes related to students being able to:
- Integrate sustainability practices into company management and policies, thus creating sustainable value.
- Manage organizational change and innovation, as building CSR into the company's management often requires significant change.
This module enables students to find responsible solutions to business problems by finding innovative solutions taking into consideration international and interdisciplinary differences.

Prerequisites:
Students are expected to have a business undergraduate degree and to have a good knowledge of corporate policy and strategy and of management in all its dimensions

Programme:

Introduction to CSR and sustainability.
- CSR concepts and theories.
- Stakeholder theory and management.
- The institutional environment of CSR.
- CSR, sustainability and corporate strategy

Comprehension of IT Sector	Brest	Autumn (S9)	30h	3

Objectives:

- Know the variety of underwater sounds
- Understand sound pressure
- Understand how sound propagation is affected by the marine environment

Prerequisites:

Basics of computer science

Programme:

- Media. (software, hardware, service, licensing, etc.)
- The economy of this sector
- Outsourcing of I.T. and its different methods of subcontracting
- Underlying trends
- Technological,
- Strategic,
- Geographical-Onshore, NearShore, Offshore…)
- The background to these trends
- Concentration towards the core business, why
- Rationalization of costs
- Juridico-legal context (why outsourced more in some countries than in others)

- Labor flexibility in a market with a shortage of resources
- Stakeholder theory and management.

Advanced Information Systems Management	Brest	Autumn (S9)	30h	3

Objectives:

- Acquire a thorough understanding of the foundations of information systems and their relationships to contemporary business strategy, operations processes and relevant internal and external data
- Understand the role of information technologies and data in supply chain management
- Model data and manage relevant enterprise and external information
- Explore the current and emerging best practices in data modelling and analytics

Prerequisites:

Introductory courses in information systems management

Programme:

- Relationships between Organizational Strategy, Structure, Processes, Data and Analysis
- Data Types and Sources

- Data Modelling and Sourcing
- Use Case, Process/Swim Lane, Data Flow and Data Dictionary Models
- Database Analysis and Design Techniques
- Structured Data and the Relational Model
- Object Database Management Systems and Big Data
- Big Data organization and analytical tools
- Web Data Management and Business Alignment
- Business Intelligence: Strategic, Operational and Tactical Approaches
- Issues in Data Management: Privacy, Security, Ethics

Contract Law In IT	Brest	Autumn (S9)	30h	3

Objectives:

This module contributes to the following programme aims:
Become a 'junior expert' in the IT business
Links with the school GRP objective (global responsible pioneer)
Through this course, students will learn that the legal IT environment defines specific responsibilities for every actors of the IT-industry.
They will understand the responsibilities of the contractual parties resulting specifically from the IT-contractual mode and/or from an IT goods and services agreement. This shall give them a solid understanding of the regulation to help them do business in the IT-sector in an appropriate and responsible manner.

Prerequisites:

None

Programme:

- Main legal principles governing the conclusion of a contract and specificities of the IT-contractual mode (e-contract)
- Main components of a contract & legal risks and requirements, particularly related to the specific IT sector
- Obligations, risks and structure of the different types of contracts concerning IT-service provision
- Intellectual property: protection of the immaterial creations (Intellectual property generally, and particularly copyright law of informational goods such as texts, music, movies, softwares and other IP protected informational goods which can be conveyed through the Internet or network

B2B Marketing	Brest	Autumn (S9)	30h	3

Objectives:
- Plan a marketing campaign using innovative marketing platforms,
- Explain the cycles of consumer adoption of innovations and the obstacles to accelerating the rate of adoption,
- Identify the competitive advantages of successful innovative companies, and the key success factors of top-rated innovative products
and services,
- Evaluate the strengths and weaknesses of major business models in the marketplace,
- Explore the potential of value in interaction co creation

Prerequisites:
Marketing Fundamentals or International Marketing

Programme:
- Business-to-Business Markets and Marketing,
- Buyer Behaviour,
- Inter-Firm Relationships and Networks,
- Business-to-Business Marketing Strategy,
- Researching Business-to-Business Markets,
- Business Market Segmentation, targeting and positioning
- Market Communication,
- Relationship Communication,
- Relationship Portfolios and Key Account Management,
- Managing Product Offerings,
- Routes to Market,
- Price-Setting in Business-to-Business Markets.

Negotiation in a B to B context	Brest	Autumn (S9)	30h	3

Objectives:
- Knowing the fundamentals of the IT world (products and services, players, etc.): a condition for selling well
- Know how to build an IT business proposal
- Know how to defend it in defense and negotiate the conditions well
- Discover a client and nurture the relationship

Prerequisites:
Students are expected to have a business undergraduate degree and to have a good knowledge of corporate policy and strategy and of management in all its dimensions

Programme:
- Understand all IT topics and related vocabulary
- Sales interview and negotiation interview techniques.
- Preparation of client meetings.
- Establish its strategy and its commercial offer.
-The management of the commercial interview and negotiation.
- Prospecting - Targeting and making contact.
- Make yourself essential: build a network of relationships within the client organization.
- Position yourself upstream of projects, adopt a winning commercial approach.

Project Management	Brest	Spring (S8)	30h	3

Objectives:
- Explain and assess project requirements (and evaluate the associated techniques)
- Analyze project quality and project risks (and evaluate associated techniques)
- Explain the alternative options - traditional or agile - to plan, monitor and control a project
- Explain the purpose of performance management in projects (and evaluate the associated techniques)
- Apply generic project tools (and evaluate the associated techniques)
- Explain the nature of project information and communication (and evaluate the associated techniques)

Prerequisites:
An Organizational Behavior Course. Students should be familiar with the various departments of a company. They should have sufficient computer skills to use Microsoft Project or similar software

Programme:
- The global transitions leading to and shaping projects in the business environment
- The main features of business projects
- The project environment
- Project management methods and approaches
- Missions and profiles of the project manager
- Project team management
- Time & resources management in a project
- Risk management
- Success & performance in a project

Competitive Strategy	Brest	Autumn (S9)	30h	3

Objectives:
- Conduct a strategic management diagnosis to identify a competitive advantage.
- Formulate decisions and strategic choices.
- Elaborate the process of implementing the strategic choices.

Prerequisites:
Marketing Fundamentals or International Marketing

Programme:
Competitive advantage
- Market, Industry Analysis and Digitalisation
- Corporate strategy, entry & Exit
- Competitive strategy in the age of platforms
- Data-Driven Decision Making and competitive strategy