FRENCH + SCIENCES PROGRAM

4 weeks

BESANÇON - DIJON - BELFORT

MICRO, NANO & SMART TECHNOLOGY

FOR INDUSTRIAL APPLICATIONS

CAMPUS FRANCE
campusfrance.org

CLA
CENTRE DE LINGUISTIQUE APPLIQUÉE
UNIVERSITÉ DE FRANCHE-COMTÉ

flə QUALITÉ FRANÇAIS LANGUE ÉTRANGÈRE
★★★ formations
★★★ enseignants
★★★ accueil
★★★ locaux
★★★ gestion

BIENVENUE EN FRANCE

The Center for Applied Linguistics (CLA) of the University of Franche-Comté in Besançon has partnered with Campus France and the Graduate School EIPHI of the Federal University of Bourgogne Franche-Comté to provide a new program of the French + Sciences in Besançon, Dijon and Belfort. The program will be offering language, cultural and scientific immersion focus on micro and nanotechnology for industrial applications.

Designed for English-speaking students, the program includes classes in French as foreign language (FLE) from A1 to B2 level, meetings with researchers, visit of laboratories such as FEMTO-ST, ICB and IMB organized by Phd students and a wide range of excursions and cultural activities.

CLA, founded in 1958, was one of the first university language centers to develop a program of practical foreign language courses based on linguistics research applied to the science of education and active learning methods.

With 4000 international Student every year, CLA is the biggest university center in France and has been recognized with the highest grade of the label Quality FLE delivered by the french government.

UBFC UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ | UNIVERSITÉ DE FRANCHE-COMTÉ | femto-st SCIENCES & TECHNOLOGIES | icb Laboratoire Interdisciplinaire Carnot de Bourgogne | INSTITUT DE MATHÉMATIQUES DE BOURGOGNE

BOURGOGNE-FRANCHE-COMTÉ

Bourgogne-Franche-Comté is a french tech labeled region through three centers of excellence: Health-Tech network, in Besançon, the Châlon-sur-Saône eco-system, which has joined the IoT and manufacturing network and the FoodTech network, in Dijon.

The Graduate School EIPHI standing for "Engineering and Innovation through Physical Sciences, High-technologies, and cross-disciplinary research" provides the training of the scientific part. EIPHI relies on three internationally renowned laboratories, FEMTO-ST , ICB and IMB covering thematic field such as mathematics, physics, , micro nanosciences and systems, computer science, mechatronics, as well as materials and energy. Their research activities can be fundamental or applied, and regularly produce a socio-economic impact. The institutes can rely on high-level technology, equipment and technological platforms.

EIPHI-BFC GRADUATE SCHOOL CROSS DISCIPLINARY SCIENCE AND TECHNOLOGY

La FRENCH TECH

GET 16 CREDITS WITH THIS PROGRAM

COURSE CONTENT

30 HOURS PER WEEK

- French as a foreign language – 15 hours per week
  - Acquisition of oral and written communication skills ;
  - Development of interculturel competence.
- Micro, Nano and Smart technology – 15 hours per week
  - Introduction to 12 topics of scientific research at University of Bourgogne Franche-Comté ;
  - Participation in tutorials and lab works ;
  - Visits to state-of-the-art laboratories and meeting with researchers ;
  - Cultural tours.
- Student performance will depend on 3 points :
  - Quality of the student's weekly journal and subsequent progress report
  - Degree of participation in program activities
  - Progress in French as a foreign language.

Non-contractual program, subject to change.
A minimum of 8 students is required.

Duration : 4 weeks
Location : Besançon, Belfort & Dijon
Price : 1 960 €

Contact :
Tel. +33(0)3 81 66 52 30
fle-cla@univ-fcomte.fr

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WEEK 1

MONDAY & TUESDAY

> **Morning** French Class

> **Afternoon :** Smart & Green Mechanics :

This course will address the design of innovative solutions for applications such as vibroacoustic control (NVH), Structural Heath Monitoring (SHM), Shape Control, or Energy Harvesting for instance. Different subjects such as smart materials with multiphysic behaviors or embedded sensors and actuators in the field of acoustics, heat transfer, or electro-magnetics will be covered through lecture, labwork and visit of S.MART technological platform.

WEDNESDAY & THURSDAY

> **Morning** French Class

> **Afternoon :** Challenges of Micro & Nano Systems :

The challenges of the miniaturisation of more and more complex and powerful systems are the subject of this course. From the concept of nano robots able to perform noninvasive surgeries, to smart Mechatronic systems which invade our daily life, nano and micro structures have a key role in the coming industrial revolutions. The challenges of understanding and mastering the manufacturing at such scales will be addressed. A visit of the Mimento technological platform will be proposed.

FRIDAY

> **Morning** French Class

> **Afternoon :** Nano-optics : Photonics permits data communication with large bandwidth, leading to the concept of fiber to the home (FTTH) but is difficult to integrate on a chip because of the diffraction limit. Nano-optics is the study of optical phenomena near or beyond the diffraction limit. This notably includes nanophotonics and plasmonics (also called optics of metals). The objective of this course is to present principles and applications of nano-optics. We will first discuss fundamentals of nano-photonics and implications to control light matter interaction at the nanoscale with examples ranging from the colors of chameleons to cavity quantum electrodynamics, and perspectives for quantum technologies. Last part will be devoted to plasmonics to overcome the diffraction limit. Visits of FEMTO-ST and ICB research labs with be organised.

SATURDAY & SUNDAY

> **Saturday :** Lausanne

> **Sunday :** Excursion to Haut-Doubs - Guided Tour of the Château de Joux, lunch at the typical Franche-Comté inn, boat trip on the Doubs river, and discovery the Saut-du-Doubs waterfall near the Swiss Border.

WEEK 2

MONDAY

> **Morning** French Class

> **Afternoon :** Non linear Fiber optics :

Nonlinear fiber optics is a very active research area motivated by a wide range of applications, ranging from high-bit-rate telecommunications to novel optical source development for material processing, environmental sensing and medicine. This short course will cover recent advances in modern nonlinear fiber optics, with a focus on novel optical frequency combs with a wide spectral range that can be extended to the mid-infrared. These disruptive fiber optic instrumentations enable remote detection of volatile compounds and diagnosis of health pathologies. Visits of FEMTO-ST research facilities will be proposed.

TUESDAY & WEDNESDAY

> **Morning** French Class

> **Afternoon :** Neural Networks & Quantum Computing : the digital electronic computer we got so used to in the past decades is reaching its performance maximum. Unfortunately, this is the consequence of fundamental physical hardware limitations and the restrictions of Turing computing. These limits become particularly relevant when simulating quantum systems and emulating neural networks. In this course we will introduce quantum information processing and neural networks and show that the two concepts share common denominators which are relevant for future hardware implementations.

THURSDAY & FRIDAY

> **Morning** French Class

> **Afternoon :** Artificial Intelligence & Complex System : manipulating medical data to infer relevant knowledge while protecting the privacy of the owner patients is at the heart of the Graduate School EIPHI Laboratory FEMTO-ST in collaboration with the Hôpital Nord Franche-Comté. This course will present sufficient components for the implementation of a privacy protection approach adapted to machine learning, all in a medical context. This short course will propose lab activities.

SATURDAY

> Excursion to Strasbourg : European Capital, headquarter of the European Parliament. Guided tour of the city center (a UNESCO World Heritage site).

WEEK 3

MONDAY

> **Morning & Afternoon :** Green Energy for Mobility : to achieve the reduction of greenhouse gas emissions new technological developments has to be made to succeed in the energy transition. Fuel cells and storage batteries are today very promising alternatives to carbon-based energy sources. Increasing their competitiveness on the economic market is today a priority issue. It should make it possible to respond very quickly to the large-scale use and recycling of electric power sources, both in the context of the expansion of the electric vehicle fleet and in that of stationary applications. This course will introduce the concept of smart grids and focus on the design complex multiphysics systems integrating hybrid electrochemical sources. A visit of FC-Lab will be proposed.

TUESDAY

> **Morning & Afternoon :** French Class

WEDNESDAY

> **Morning & Afternoon :** New Material for a Green Planet : pollution by volatile organic compounds (VOCs) is one of the most important factors of morbidity (6 to 7 million deaths per year according to the UN). There are multiple sources of VOCs (exhaust gas, evaporation of solvents, degassing of plastics, fire smoke, etc.) and, since they cannot be eradicated, there is an urgent need to design efficient and controlled air purification systems, especially in indoor living spaces (schools, workshops, vehicle interiors, etc.). The course will present how new materials can be used to trap by adsorption the VOCs present in the air and ICB research facilities.

THURSDAY

> **Morning & Afternoon :** Quantum Physics & Technologies : one of the main challenges in Quantum Physics is the control of quantum dynamics by external electromagnetic fields. The objective of the course is to present a geometric approach based on the Tennis Racket Effect to manipulate the state of a qubit. It can be shown that the robustness of the classical geometric effect can be transposed to some extent in the quantum world. The fields covered will be the classical rotation of a rigid body, the description of integrable systems by complex geometry and the robust control of qubits.

FRIDAY

> **Afternoon :** Mathematics for Applied Physics in Health Science : an application in Health Science :

This course aims at describing how various domains of pure and applied Mathematics and informatics can come together to provide methods and tools for modern medical imaging applications. We will explain the mathematical side of Electric Impedance Tomography, a promising technique for medical imaging which neither exposes the patient to radiation like CT nor requires large, expensive devices as MRI. We will present the necessary mathematical notions from generally disconnected parts of mathematics as geometry, partial differential equations and scientific computing.

SATURDAY & SUNDAY

> Excursion to Lyon

> Dijon & Beaune

WEEK 4

MONDAY

> **Morning & Afternoon :** Innovative Drugs & Nano-technologies : recent years have witnessed unprecedented growth of research and applications in the area of Nanoscience and Nanotechnology. There is increasing optimism that nanotechnology, as applied to medicine, will bring significant advances in the diagnosis and treatment of disease. Anticipated applications in medicine include drug delivery, diagnostics, cell therapy and production of biocompatible materials.This course present the state of the art of this domain and the research performed locally. A visit of ICB research facilities related to this topic will be proposed.

THURSDAY & WEDNESDAY

> **Morning** French Class

> **Afternoon :** Time-Frequency Metrology & Quantum Physics : France has always played a key role in the field of time-frequency metrology. In this course we will present the basic tools, the state of the art and the main applications of this domain. Subjects such as oscillators and atomic clocks (in the microwave and optics domains), quantum phenomena and superradiance will be covered.

THURSDAY & FRIDAY

> **Morning & Afternoon :** French Class

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