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## 2EL1430 – Nuclear engineering

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**Instructors:** Pascal Yvon

**Department:** DÉPARTEMENT MÉCANIQUE ENERGÉTIQUE PROCÉDÉS

**Language of instruction:** ANGLAIS

**Campus:** CAMPUS DE PARIS - SACLAY

**Workload (HEE):** 60

**On-site hours (HPE):** 35,00

**Elective Category :** Engineering Sciences

**Advanced level :** No

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### Description

This course will present the operating principles of nuclear reactors and describe in details all the stages of the civilian nuclear fuel cycle. The students will be able to appreciate, from technical, economical and environmental perspectives, the advantages and drawbacks of this low carbon source of energy, and its role in present and future world energy landscapes.

### Quarter number

SG8

### Prerequisites (in terms of CS courses)

Basic notions of physics and chemistry

### Syllabus

- Principles of nuclear fission
- Operation of pressurized water reactors
- Interactions neutrons matter
- Generation IV reactor systems and Small Modular Reactors
- Natural and secondary ressources, mining methods, "yellow cake", uranium chemistry
- Uranium enrichment: isotopic separation techniques (gaseous diffusion, ultra-centrifugation, others ...)
- Fuel fabrication and in pile behavior
- Circular economy, reprocessing and waste management: spent fuel recycling
- Transport of nuclear materials
- Futures trends and R&D: a young proven energy with even more promises

### Class components (lecture, labs, etc.)

33 h of Lectures



### **Grading**

Written exam of 2 hours (without class notes) - Oral repeats

### **Learning outcomes covered on the course**

- Operating principles of pressurized water reactors
- Abundance of resources of uranium, the only natural fissile material
- Introduction to mining, enrichment and reprocessing technologies for the nuclear "fuel"
- Impact of neutron irradiation on microstructure and behavior of materials
- Fabrication and behavior of nuclear fuel
- Radioactive waste management: issues and solutions
- Future developments and prospective for nuclear processes and technologies (Generation IV, SMR)

### **Description of the skills acquired at the end of the course**

Good understanding of the operation of pressurized water reactors and of the nuclear fuel cycle. Understanding of the stakes of electricity production and of the position of nuclear energy in a low carbon mix.