EN1500 Nuclear Engineering

Professor : Pascal YVON

Language of instruction : ANGLAIS – **Number of hours** : 36 – **ECTS** : 3,0 - **Quota** : 78

Prerequisites :

Period : S8 elective 9 between february and june

Course Objectives

- Describe the operating principles, the science, technology, and technological roadblocks of a new generation nuclear plant for electric energy production.
- Describe the nuclear fuel cycle (the characteristics of uranium and other nuclear fuels, and the various front-end and back-end industries and processes), as well as the industrial, theoretical, and experimental solutions for the management of the nuclear waste.

On completion of the course, students should be able to

understand the operation of the various nuclear technologies, the interest of the duifferent types of reactors in the future energy mix, the advantages and drawbacks of nuclear energy compared to other sources of energy, as well as the fields where research will make it possible to overcome technological roadblocks and also to open new options for future fuel cycles and reactor strategies

Course Contents

- Description of the operation of a thermal neutron reactor (PWR). Different types of nuclear reactors.
- Neutronic aspects: neutron-matter interactions, description of the various neutron reactions, neutron balance in a nuclear core, nuclear core in normal operation.
- Thermohydraulic aspects: coolant (water), nominal operation, boiling crisis.
- Heat sink and interactions with the environment
- Materials (pressure vessel, internal structures, fuel). State of the art and current research.
- The fuel cycle: uranium resources and mining, uranium chemistry, enrichment, fuel design and fabrication, in-reactor behavior, reprocessing, recycling (RepU, MOX), transport of radioactive material.
- Nuclear waste: classification, treatment, different policies in various countries, focus on high level waste solutions, long term radiotoxicity, final repositories.

- Future developments: 4th generation reactors (in particular fast breeders), future fuel cycles, long-term resources, thorium, transmutation, fusion.

Course Organization

Lectures: 18 hr, Tutorials: 15 hr, Exam: 3 hr

A one-day visit (in addition to the scheduled classes) of a nuclear site (and/or CEA) could be organized.

Bibliography / Teaching Material and Textbooks

Slides in english available on Claroline

summaries in english available on Claroline

Resources

Lecturers: Pascal Yvon (CEA), Hervé Cordier (EDF), Jean-Luc Salanave (Areva)

Evaluation

3-hr written final exam without documents

This exam will be in 3 parts: reactors (40% of the grade), fuel cycle (40% of the grade) and materials (20% of the grade).