



## INGÉNIERIE NUCLÉAIRE

### NUCLEAR ENGINEERING

Lecturers: Anne-Segolene CALLARD, Anne LAMIRAND, Bertrand VILQUIN

| Lecturers : 20 | TC : 12 | PW : 0.0 | Autonomy : 2.0 | Study : 0.0 | Project : 0.0 | Language : FR

#### Objectives

Nuclear engineering covers a wide scientific and economical field that is enriched by the multiple relations with other disciplines. Its applications field extends from energy production (nuclear fission and fusion reactors) to the analysis and treatment of materials, the use of radio-elements (radioactive tracers) in medicine, biology and geology beyond to medical applications in radiotherapy and nuclear imaging. The aim of the course is to give the physical basis of nuclear engineering and to illustrate some of the applications previously mentioned. The lessons will be followed by two conferences (Nuclear reactors of next generation and radio-protection) given by specialists of the field.

**Keywords :** Nuclei, nuclear decays, radioactivity, liquid drop model, shell model, fusion, fission.

#### Programme

1. Nuclear structure, energy considerations in nuclear physics, notions on cross section of interaction. Nuclear stability and nuclear models.
2. Nuclear instabilities: the different types of radioactivity, basic notions of radio-protection.
3. Nuclear reactions and applications.
4. Nuclear fission, basis of neutronics and principle of operation of a nuclear reactor.
5. Nuclear fusion.
6. Nuclear applications in chemistry, biology, medicine. Radioactive tracers and applications, medical imaging.

#### Learning outcomes

- Identify the application fields of nuclear physics.
- Evaluate orders of magnitude in nuclear processes.
- Be able to equilibrate a nuclear reaction and to calculate mass transformation.
- Be able to distinguish and to describe the different types of radioactive decays.

#### Independent study

**Objectifs :** During the tutorials, students must resolve some exercises, using the concepts developed during the lessons.

**Méthodes :** This work is done by a group of 2 persons and is evaluated by a reporting at the end of each session.

#### Core texts

W.E. Meyerhof, *ELEMENTS DE PHYSIQUE NUCLÉAIRE*, Editions Dunod., 1970  
Daniel Blanc *NOYAUX, PARTICULES, RÉACTEURS NUCLÉAIRES*, Masson, 1987  
P. Bonche *LE NUCLÉAIRE EXPLIQUÉ PAR LES PHYSICIENS*, EDP Sciences, 2002

#### Assessment

Final mark =60% Knowledge + 40% Know-how  
Knowledge =100% final exam  
Know-How= 100% continuous assessment