

## Faculty of Biological, Agronomic and Environmental Engineering

### BRNA2202 Nano-biotechnologies

[22.5h] 2 credits

This course is taught in the 1st semester

**Teacher(s):** Yves Dufrêne  
**Language:** French  
**Level:** Second cycle

#### Aims

The course aims at providing students with a detailed knowledge of the concepts, tools and implications of nanobiosciences et nanobiotechnology.

In terms of know-how, the course integrates complementary disciplines, at the crossroad between nanosciences, biosciences, physical chemistry and engineering. In addition, students will learn how to analyze and criticize recent publications in the field of nanobiosciences.

#### Main themes

At the meeting point between nanosciences and biology, nanobiotechnology aims at creating, characterizing and exploiting biosystems on the nanometer scale. In view of its numerous applications, this fast-moving area is attracting more and more attention both in basic research and in industry. The course aims at providing a survey of the concepts, methods and challenges of nanobiotechnology.

Following a general introduction on nanosciences, the course describes the main nanocharacterization and nanofabrication methods. In particular, we show how the tools of nanotechnology (scanning probe microscopies, lithography) can be used to explore and transform biosystems at the level of single atoms and molecules, on the one hand, and how the basic principles of biology (self-assembly) can be used to elaborate new materials and devices, on the other hand. Finally, the applications and perspectives are discussed (dream vs reality), together with the main limitations and technological challenges remaining to be addressed. In this context, ethical issues associated with the use of nanobiosystems will be discussed.

#### Content and teaching methods

1. Nanotechnology : history, basic concepts, application fields
2. Nanocharacterization methods : scanning probe microscopies, nanoparticles
3. Nanofabrication methods :
  - top-down approaches: lithography, nanomanipulations
  - bottom-up approaches: self-assembly, supramolecular chemistry
4. Applications and perspectives of nanobiotechnology :
  - microfluidics and nanofluidics (biochips, 'lab-on-a-chip')
  - nanostructures (molecular motors, nanomachines, ionic channels, DNA scaffolds, dendrimers, biomembranes)
  - nanoparticles (liposomes, magnetic particles, gold particles, nanoshells, quantum dots)
  - biocompatible materials, hybrid materials, biomimetic materials
  - electronic and mechanical devices for biodetection (biosensors)

The oral presentation is completed by practical works in the laboratory in order to illustrate nanocharacterization and nanofabrication methods, as well as by a seminar consisting in a critical discussion of recent articles published in the area.

#### Other credits in programs

**BIR23/3C** Troisième année du programme conduisant au grade de (2 credits)  
 bio-ingénieur : chimie et bioindustries (Nanobiotechnologies, matériaux et catalyse)