**Master Thesis subjects proposed by the**
***Engineering of Molecular NanoSystems* laboratory in 2019-2020.**
**MSc in Biomedical Engineering**

**1. Nucleic acids driven assembly of nanoparticles at the surface of biological membranes.**
Summary: Gold nanoparticles (GNPs) are of particular interest for biomedical diagnostic and therapeutic applications because of their remarkable optical properties, ease of surface functionalization and presumed biocompatibility. In particular, the photothermal properties of GNPs and ease of detection using photoacoustic imaging make them an ideal theranostic tool. For in vivo applications however, the plasmon band (LSPR) of GNPs, which falls in the visible range, is not ideal and the near-IR would be more suitable. This shift can be obtained by the controlled assembly of the GNPs. This project will aim at controlling the assembly of GNPs at the surface of a target membrane using a bioinspired strategy based on the use of nucleic acids. Nanoparticles will be synthesized and functionalized with different DNA oligonucleotides encoding for the targeting of membranes functionalized with a complementary strand but also for their assembly at the surface.

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**2. Design of nucleic acids coated nanoparticles for miRNA delivery in ovarian cells.**
Summary: Chemotherapy drugs such as cyclophosphamide are highly gonadotoxic and can lead to ovarian reserve depletion, causing infertility and thus strongly affecting the quality of life in young patients. The EMNS laboratory works in collaboration with the Laboratory of Human Reproduction from the Erasme hospital that has recently identified microRNAs as therapeutic options to preserve fertility during chemotherapy exposure. MiRNAs are small non-coding molecules, which offer new promising approaches in cancer therapy but also in fertility preservation, as they play a key role in ovarian function. However, these miRNA have to be delivered to the ovarian cells, which requires the development of new delivery systems. Gold nanoparticles (GNPs) are promising vectors, which have already been successfully used for nucleic acid delivery. In this study, we propose a new approach of GNPs surface functionalization based on calix[4]arenes which can be used to control the anchoring of synthetic miRNA nucleotides and/or of other ligands (peptides) for organ specific targeting. The goal of this project is to create novel ovarian protective drugs by combining the favorable characteristics of miRNAs and the cutting-edge technology of GNPs.

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