FI280 - **Tópicos de Nanociência e Materiais Avançados II**

Objectives:
Nanoparticles are not just small pieces of matter, their physical and chemical properties can be very different from their macroscopic counterparts and drastically vary with size, shape, environment etc. This course provides a comprehensive introduction to the physical foundations. The relevant experimental and theoretical tools and concepts will be introduced, moving from basic concepts like quantum size effects to examples such as nanomagnetism and nanocatalysis.

Content:
Unique new materials with unprecedented properties can be developed if one can manipulate the material composition on the nanoscale. Many physical properties are size dependent and dramatically changed if the individual primary particles have nano size. This lecture addresses the basic concepts and phenomena that one encounters when reducing the size of a physical object to the nanometer scale. Some key experiments on size-induced properties are discussed in detail. The prospects and boundary conditions for the construction and application of nanoscale materials are discussed.

1. Nanoscale materials and their novel properties
2. From clusters to nanomaterials: Generation, manipulation and detection of clusters
3. Structure and electronic properties:
    a. Geometric and electronic shell models
    b. Size dependent properties and transitions
4. Thermodynamic properties:
    a. Thermodynamics in reduced dimensions
    b. How do nanosystems melt
5. Cluster magnetism:
    a. From the gas phase to the bulk
    b. Spin-dependent transport in cluster-assembled nanostructures
6. Nanocatalysis:
    a. Examples of catalytic processes
    b. Catalysis on the atomic scale
7. Carbon based nanomaterials
    a. Carbon clusters and fullerenes
    b. Carbon nanotubes and graphene