Level of education: **Master**
Field of study: **16.04.01 Technical Physics**

Advanced Quantum and Nanophotonic Systems

INTRODUCTION TO MATERIALS SCIENCE (PART 1)

Credits: 3 ECTS		
Semester		**Assessment**
2nd semester	3 ECTS	Exam

Course developers: **Alexandre Nominé**

Materials science is a course that studies the patterns that determine the structure and properties of materials depending on their composition and processing conditions. The purpose of the course is to give the basics of materials science, the principles of choosing structural materials, the technology of their production and processing; to instill skills of practical determination of physical and mechanical properties of materials and direct impact on them; to expand the scientific and technical horizons of students. Objectives of the lectures: to acquaint students with the current state of the science of the structure and properties of metallic and non-metallic materials, methods of production and processing; to teach students to navigate the variety of modern structural materials, to know their classification and labeling, as well as the main trends in the creation of materials of the future based on the achievements of scientific and technological progress.

Requirements

1. Basics inorganic chemistry.
2. Mathematical analysis and differential equations.
3. Basics of thermodynamics and heat transfer theory.
4. Basics of crystallography, solid state physics and mechanics.

All relevant courses and prerequisites are ordinary included in Physics, Chemistry or Mechanical engineering bachelor's programs.

Course structure

1. UNDERSTAND THE CRYSTALLOGRAPHIC CLASSIFICATION OF MATERIALS
   - Structure
   - Symmetries

2. DEFECTS OF CRYSTALLINE STRUCTURE
   - Origin
   - Types
   - Influence on properties

3. BASICS IN THERMODYNAMICS OF MATERIALS
   - Gibbs energy curves

4. HOW DO MATERIALS GROW?
   - Thermodynamic approach (Surface vs. Volume)
   - Kinetic approach (JMAK models)

5. HOW DOES MICROSTRUCTURE INFLUENCE PROPERTIES?
   - Mechanical
   - Optical
   - At different scales

6. PROCESSES TO CONTROL MATERIALS MICROSTRUCTURE

Assessment

- Test (1:30 hour) with all documents allowed
- Presentation of the materials science problematic
- Home assignments

Faculty: **Faculty of Physics**

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Tags: **Materials science, phase diagram, structure, physical chemistry, thermodynamics, X-Ray diffraction, nucleation, properties of materials, overcooling, solidification**