Reg No: CBGB06/20252

Faculty of Health, Science and Technology
Physics

Syllabus

Nanoscience I

Course Code:	CBGB06
Course Title:	Nanoscience I *Nanovetenskap I*
Credits:	7.5
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has at least 60 credits in first-cycle course/s as entry requirements (G2F)

Major Field of Study:
FYA (Physics)
TKA (Engineering Physics)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2025-02-26, and is valid from the Autumn semester 2025 at Karlstad University.

Prerequisites
Mathematics 30 ECTS credits, including Calculus and Geometry, 7.5 ECTS credits, and Physics 30 ECTS credits, including Wave Physics and Optics, 7.5 ECTS credits, Introductory Modern Physics, 7.5 ECTS credits, and Thermodynamics and Statistical Physics, 7.5 ECTS credits, or equivalent

Learning Outcomes
Upon completion of the course students should be able to:
- present an overview of the various areas of nanoscience,
- explain some basic phenomena appearing on the nanoscale in physics and chemistry,
- describe the most important methods for characterising nanostructures, and choose an appropriate method for a certain investigation,
- describe the most important methods for the synthesis of nanostructures, and choose

method depending on the need for a certain structure,
-give examples of and analyse applications of nanotechnology in the areas of materials science, electronics and computer science, energy and environmental technology, and medicine,
- give an account of and assess how nanoscience affects the development of society and how the use of nanotechnology can affect life and environment,
- search for and select relevant literature about research on nanoscience, and
- plan, compile, and present, both orally and in writing, the results of a minor investigation to a group of colleagues with similar basic knowledge.

Content
Instruction is in the form of lectures, seminars, projects, and laboratory work. Attendance is mandatory for all laboratory sessions.

Areas treated in the course:
- Foundations of Nanoscience: What is nano? Basic physical properties and phenomena in nanometer-sized structures.
- Tools of Nanoscience: Experimental methods for the characterisation of nanostructures (spectroscopy and microscopy) and their manipulation.
- Nanoparticles: metals, semi-conductors, and molecular materials.
- Nanomaterials: Carbon-based: fullerenes, carbon nanotubes, grapheme and organic molecules and polymers.
- Nanomaterials: Ordered and unordered composites: Modifying material by adding nanoparticles to change properties; mechanical, electronical, optical, and magnetic.
- Synthesis of nanoparticles and nanomaterials: quantum wells, quantum wires, quantum dots, and so on, with top-down and bottom-up methods.
- Nanoelectronics and nanooptics: single-electron electronics, Magnetic Random Access Memory (MRAM), quantum computers, photonic crystals, nanolasers, nanoelectromechanical systems (NEMS).
- Nanotechnology and energy applications: solar cells and fuel cells.
- Nanotechnology and environment applications: catalysis and purification.
- Nanoscience and medical applications: lab-on-a-chip, biosensors, nanoparticles for diagnosis and drug dosage.
- Applications of nanotechnology, e.g. single-electron transistor, catalysis, NEMS, solar cells, molecular electronics, functional materials, medical diagnosis and therapy.
- Market for nanoscience inventions and companies.

Reading List
See separate document.

Examination
Assessment is individual and based on a written exam, hand-in assignments, laboratory reports, and written and oral presentations of projects. Participation in laboratory sessions is mandatory.

If students have a decision from Karlstad University entitling them to Targeted Study Support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades
One of the grades 5 (Pass with Distinction), 4 (Pass with Some Distinction), 3 (Pass), or U (Fail) is awarded in the examination of the course.

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.