



Board of Teacher Education  
Physics

## Syllabus

### Physics IV and Physics Education

<b>Course Code:</b>	FYAL91
<b>Course Title:</b>	Physics IV and Physics Education <i>Fysik IV med didaktisk inriktning</i>
<b>Credits:</b>	7.5
<b>Degree Level:</b>	Master's level
<b>Progressive Specialisation:</b>	Second cycle, has only first-cycle course/s as entry requirements (A1N)

**Major Field of Study:**  
FYA (Physics)

#### Course Approval

The syllabus was approved by the Board of Teacher Education 2017-03-02, and is valid from the Autumn semester 2017 at Karlstad University.

#### Prerequisites

Mathematics 30 ECST cr, including courses in calculus and linear algebra, Physics 30 ECTS cr, including electricity, wave physics, quantum physics and thermodynamics

#### Learning Outcomes

Upon completion of the course, students should be able to:

1. give an outline of the areas of nanoscience,
2. explain some basic phenomena occurring on the nanometer scale in physics and chemistry,
3. describe the most important methods for characterising nanostructures, and choose an appropriate method for a certain type of investigation,
4. describe the most important methods for the synthesis of nanostructures and choose method with regard to the type of nano structure preferred,
5. give examples of and analyse nanotechnological applications in materials science, electronics and computer science, energy and environmental technology, and medicine,
6. give an account of and assess how nanoscience impacts on societal development and how the use of nanotechnology can affect life and the environment,
7. seek and make appropriate selection of research literature in the area, and
8. plan, compile, and present results of a minor investigation, orally and in writing, to colleagues with similar basic knowledge.

#### Content

Instruction is in the form of lectures, seminars, project and laboratory work.

Areas treated in the course:

- Foundations of Nanoscience: What is nano? Basic physical properties and phenomena in

nanometer-sized and lowdimensional structures.

- Tools of Nanoscience: Experimental methods for the characterization of nanostructures; spectroscopy, microscopy and manipulation.
- Nano particles: 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 magnetical.
- Synthesis of isolated nanoparticles and nanomaterials: quantum wells, quantum wires, quantum dots, with top-down and bottom-up methods.
- Nanoelectronics and nanooptics: single-electron electronics, MRAM, quantum computers, photonic crystals, nanolasers, 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 based on:

Learning outcomes 1 - 6: oral and written exam.

Learning outcome 3: laboratory experiment and lab report.

Learning outcomes 7 and 8: oral and written presentation of a project.

Laboratory sessions are mandatory and assessed.

### **Grades**

One of the grades Distinction (VG), Pass (G), or Fail (U) 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.

Teacher Education: Secondary school levels