Nanoscience and Technology Elective Package

Nanoscience and Technology	
Offered by	Department of TN, ST, EE
Language	English
Primarily interesting for	All students, but most relevant for students with background in TN, ST, EE
Prerequisites	Required courses: calculus (2WBB0 or 2WCB0), Applied Natural Sciences (3NBB0)
Contact person	Prof. Dr. B. Koopmans (B.koopmans@tue.nl)

Content and composition

Nanoscience and nanotechnology are intimately related. Together they form a research area in which state-of-the-art science and high-end technological applications go hand in hand. In this track students will establish a quantitative picture of the most important aspects of 'nano'. In the three courses, preparation & fabrication of nanomaterials, physical properties & characterization of nanomaterials and device applications & system integration will be discussed successively. This way, the whole chain of knowledge, from designing the properties, via making the objects to their final use will be treated. All course consist of a combination of theory and relevant examples, ranging from medical sensors to intelligent coatings, and from applications in ICT to sustainable energy.

Course code	Course name	Level classification
6E12X0	Nanomaterials: Chemistry and Fabrication	1.
3ENX0	Nanomaterials: Physics and Characterization	2.
5XPB0	Nanomaterials: Devices and Integration	3.

Course description

Nanomaterials: Chemistry and Fabrication (6E12X0)
In this course, the broad field of Nanoscience and nanotechnology will be introduced, with a strong emphasis on how nanomaterials and nanodevices can be fabricated using bottom-up and top-down techniques. A quantitative theoretical description of the most relevant production processes will presented, such as used e.g. in the production of (future) telecom components, sensors and dyes. Cross links with other field of research such as thermodynamics will be addressed.

Nanomaterials: Physics and Characterization (3ENX0)
The first objective of this course is to provide students with a conceptual picture of the special properties of nanomaterials, and how these properties quantitatively depend on the (nanometer) length scales. The second objective is to introduce the principles of contemporary techniques used to characterize nanomaterials. For both objectives basic knowledge of quantum mechanics is essential; a brief introduction thereof –aiming at students with no background therein– forms an integral part of the course.

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Nanomaterials: Devices and Integration (5XPB0)

The course subatomic physics starts with the experimental observations which provided insight in the size and structure of the atomic nucleus. Two early models of the nucleus will be introduced: the semi-empirical mass model and the independent particle shell model based on quantum physics. Subsequently, alpha, beta and gamma emission will be discussed as well as some applications such dating with radioactive sources as well as isotope production for medical purposes. Subsequently, accelerator induced nuclear reactions will be described followed by the concepts of nuclear fission and fusion. The use of accelerators with increasing energy finally shows the limitations of the early models of the nucleus and led to the discovery of many new elementary particles. The elementary concepts of Feynman diagrams will be discussed followed by an introduction into the classification of elementary particles and the framework of the standard model.