

Course: Introduction to nanotechnology		
Language: English		
Lecturer: Prof. Stanislav Kurajica; Prof. Sanja Lučić Blagojević		
TEACHING	WEEKLY	SEMESTER
Lectures	2	30
Laboratory	0	0
Seminar	1	15
		Overall:45
		ECTS: 4

PURPOSE:

Accepting of the basic terms of nanotechnology. Acquiring knowledge on properties of nanomaterials. Getting acquainted with methods of preparation and characterization of nanomaterials. Acquaint with the most important kinds of nanomaterials and its applications.

THE CONTENTS OF THE COURSE:

1. Concepts of nanoscience and nanotechnology, molecular nanotechnology. History of nanotechnology, Gordon E, Moore, Richard P. Feynman, Eric K. Drexler, R. Kurzweil. Phenomena on nano-level: quantum effects, surface to volume ratio, the dominance of electromagnetic forces.
2. Properties of nanomaterials: physical, mechanical, chemical, optical, electrical, magnetic. Tunelling effect, quantum confinement, quantum dots, nanostructure, magical numbers. Hall-Petch effect, superparamagnetism, giant magnetoresistance, lotos effect.
Laboratory exercise 1. The determination of crystallite size using Scherrer method.
3. Characterization of nanomaterials. Scanning electron microscope, transmission electron microscope, scanning tunneling microscope, atomic force microscope.
Laboratory exercise 2. Synthesis of silver nano-particles.
4. Nano-manufacturing: top-down approach: photolithography, soft lithography, microcontact printing, nano-print lithography, dip-pen nanolithografy, high-energy milling, PVD, CVD.
Laboratory exercise 3. The preparation of superparamagnetic nano-particles.
5. Nano-manufacturing: bottom-up approach: precipitation, crystallization, colloids, colloid stabilization, solid suspensions, self-assembly, micelles, thin films, self-assembled monolayers, dendrimers, super-latices, sol-gel method. Nanomanipulation, contact and contactless nanomanipulation. The aims for nanomanipulation.
Laboratory exercise 4. Sol-gel synthesis of SiO₂ nanoparticles.
6. Trends in nanotechnology: Nanomaterials (nano-structured materials, smart materials, ageless materials), nanoproducts (electronics, medicine, environment, industrial technology). Nanorobots. The applicative potential of nanomaterials. Sociological

acceptance of nanomaterials. Risks of nanotechnology Future of nanotechnology.

7. I. Partial exam

8. Carbon nanostructures; Fullerene – synthesis, properties, reactivity, potential application; Carbon nanotubes – molecular and supramolecular structure, intrinsic properties, synthesis, purification, modification, application

9. Nanoscale electronic, Development of microelectronic devices and technology, Structure and operation of MOF transistor; Transistor scaling, Nanoscaled MOFSET transistors;

10. Molecular electronic – possibilities, preparation and investigation of molecular devices; Molecular switches, transistors and similar devices; Electronic with DNA molecules; Single electron electronic devices

11. Nanocomposites – preparation, structure and properties

12.-13. Nanobiotechnology – biomimetic nanostructures, interface with biologic structure and functions: Biomolecular motors – MEMS and biomolecular motors. Operations and functions of motor proteins; Biotechnology of motor proteins; Science and engineering of molecular motors, Engineered devices; Molecular motors in technological application

14. II. Partial exam

GENERAL AND SPECIFIC COMPETENCE:

Knowledge of basic concepts of nanoscience and nanotechnology. Noticing the diversity properties of nano-materials and macro-materials and understand the reasons of these differences. Knowledge of ways of getting nanomaterials on the principle top-down and bottom-up. Knowledge of basic methods of characterization of nanomaterials. Understanding the trends in nanotechnology.

KNOWLEDGE TESTING AND EVALUATION:

Partial exams, written/oral exam

MONITORING OF THE COURSE QUALITY AND SUCCESSFULNESS:

Student questionnaire

LITERATURE:

1. Di Ventra M., Evoy S., Heflin R.J., Introduction to Nanoscale Science and Technology, Springer, 2004.
2. Owens P., Introduction to Nanotechnology, John Wiley & Sons, 2003.
3. Wilson M., Kannangara K., Smith G., Simons M., Raguse B., Nanotechnology, basic science and emerging technologies, Chapman & Hall, 2002.