Course title: Physics of Funcional Materials

Status: elective

ECTS: 30

Requirements:

Learning objectives

Getting contemporary knowledge about the models and physical properties of matter in condensed state and the application of functional materials.

Learning outcomes

Possibility of a scientifically based understanding of physical processes and the interpretation of physical phenomena of functional materials.

- Ability to follow professional literature and to prepare scientific reports
- The ability to participate in teaching as a demonstrator in this field.

Syllabus

Theoretical instruction

The influence of structural ordering on material properties. Phenomenological physical processes in materials with ordered and disordered internal structure. Interdependence in the triad of "synthesis-structure-properties" for functional materials. Physics of materials for electronics and optoelectronics. Metals and alloys. Amorphous metals. Amorphous and nanostructured chalcogenide semiconductors and glass-ceramics. Materials for optical applications. Luminescent materials. Heat conductors and insulators. Special ceramic materials. Thermoelectric materials. Polymeric materials. Crystalline and amorphous polymers. Materials for solar panels. Metal and non-metallic materials modified with electro conductive polymers for use in new technologies. Quasicrystals. The concept of non-crystalline symmetry, quasi-periodic cells, thin layers of quasicrystals. Superconducting compounds and alloys. Exotic superconductors. Contemporary magnetically soft and magnetically hard materials. Carbon-based materials: diamond, graphite, fularen, carbon nanotubes and wires. Nanostructured photocatalysts. Materials of reduced dimensions for efficient light absorption and energy conversion. Thin layers of crystalline and non-crystalline internal structure. Microstructural characteristics, defects and impurities. Models of growth and formation of thin layers. Optical properties of thin films.

Practical instruction

Preparation and public defense of seminar works that follow and supplement the lecture program.

Recomanded literature:

1. D.M. Petrovic, S.R. Lukic, *Eksperimentalna fizika kondenzovane materije*, Edicija “Univerzitetski udžbenik”, Univerzitet u Novom Sadu, Novi Sad, 2000.
2. Steven H. Simon, *The Oxford Solid State Basics*, Oxford University Press, Oxford, 2013..
3. S.R. Elliott, *Physics of Amorphous Materials*, Wiley, New York, 1989.
4. M. Popescu, *Non-Crysralline Chalcogenides*, KLUWER ACADEMIC PUBLISHERS, New York, 2008.
5. Stephen Blundell, *Magnetism in Condensed Matter*, University Press, Oxford, 2004.
6. Mark Fox, *Optical Properties of Solids*, University Press, Oxford, 2005.
7. P. Hofman, *Solid State Physics*, Wiley-VCH, New York, 2008.
8. Charles Kittel, *Introduction to Solid State Physics*, Wiley-VCH, New York, 2005.
9. G.Stojanović, *Nanoelektronika i promena nanomaterijala*, UNS, FTN, 2012
10. W. D. Callister, *Materials Science and Engineering: An Introduction*, John Wiley & Sons, Inc., 2007.
11. C. Janot, *Quasicrystals. A primer*. 2nd ed. Clarendon Press, Oxford, 1994.
12. M. Ohring, *Engineering Materials Science*, Elsevier, New York, 1995.
13. Siegmar Roth, David Caroll, *One – Dimensional Metals*, WILEY-VCH Verlag GmbH & Co., Weinheim, 2004
14. David K Ferry, *Semiconductors, Bonds and bands*, IOP Publishing Ltd , Bristol, 2013
15. J. A. Brydson, *Plastics materia1s* - 7th ed, Butterworth-Heinemann, Oxford, 1999.

A. Zakery S.R. Elliott, *Optical Nonlinearities in Chalcogenide Glasses and their Applications*, Springer Berlin, 2007.

Weekly teaching load

Lectures: 5	Scientific work: 15