

Questions for diploma exam – NT2

Gdańsk Tech-IKBFU Double Degree Programme
Functional Nanomaterials and Advanced Technologies

1. Electronic structure of atoms. Types of chemical bonds and valence bond theory.
2. Crystalline and amorphous solids: characteristic structural parameters and physical properties.
3. The density of states, Fermi surface and band theory of electrical conductivity.
4. Ferromagnetism: phase transition to the ferromagnetic state, the role of exchange interaction, Curie point and ferromagnet susceptibility.
5. Magneto-optical effects: Faraday, Voigt and Kerr effects.
6. X-ray, neutron, and electron diffraction on crystals: basic principles and limitations.
7. Principles and applications of Raman spectroscopy. Inelastic light scattering process, Jablonski diagram, Raman shift, Stokes and anti-Stokes lines, detectable vibrational modes of molecules.
8. Principles of IR spectroscopy and its application to organic compounds analysis. Light absorption process, detectable vibrational modes of molecules.
9. Atomic Force Microscopy: basic principles.
10. Transmission electron microscopy: basic principles.
11. Nanoscale fabrication methods: “bottom-up” and “top-down” approaches and basic principles.
12. Maxima: general structure, data types, basic operations.
13. MatLab: general structure, data types, basic operations.
14. Maple: general structure, basic rules.
15. Thin-film synthesis and characterization.
16. Physical and chemical synthesis of magnetic nanoparticles (describe up to two methods and their basic principles).
17. Magnetic properties of nano-scale materials and their applications (up to 2 examples of each material).
18. Composites and smart materials based on multiferroics: main properties and their applications (up to 3 examples).
19. Application of magnetic nanoparticles in biomedicine: treatment and diagnostics.
20. Variational Ritz method: description and applicability.

21. Triplet and singlet open-shell states of molecules: general description, the energy of states. Which state has lower energy and why?
22. Estimation of energy of a chemical reaction for which the spins of the reactants and product are different.
23. The molecular dynamics (MD) method: a principle of operation, advantages and limitations.
24. Periodic boundary conditions in a computer simulation. Why and when are they used, how do they work, what are their main limitations?

Dziekan
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WYDZIAŁ FIZYKI TECHNICZNEJ
I MATEMATYKI STOSOWANEJ
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