GDAŃSK UNIVERSITY OF TECHNOLOGY

FACULTY OF APPLIED PHYSICS AND MATHEMATICS

UNIVERSITÀ DEGLI STUDI DELL'AQUILA

QUESTIONS FOR DIPLOMA EXAM – NT2

UNIVAQ-Gdańsk Tech Double Degree Program

CONDENSED MATTER PHYSICS AND NANOTECHNOLOGY

1. Physics of semiconductors.
2. Transport properties in solids within the i) Sommerfeld and ii) Boltzmann formalism.
3. The gas liquid transition with some examples from the lattice gas.
4. Dissipation and equilibration, examples from the Langevin equation.
5. Electronic states and energy levels of two-electron atoms.
6. Specific heat of solids.
7. The Poisson process and the paralyzable and non paralyzable models for the detector dead time correction in photon counting.
8. The relativistic corrections to the fields emitted by accelerated charged particles.
9. Illustrate the phenomenology of weak interactions using examples and the relevant Feynman diagrams at first order.
10. Property of mesons and their description in the 3 flavours (u,d,s) quark model.
11. Nanoscale fabrication methods: "bottom-up" and "top-down" approaches and basic principles.
12. Comparison of sputtering and evaporation PVD processes.
13. Determination of chemical composition. List and describe briefly at least 3 methods.
14. Methods for imaging nanostructures: types, principles of operation, limitations.
15. Describe magnetic domains and explain why they are formed.
16. Describe giant magnetoresistance (GMR) and tunnel magnetoresistance (TMR).
17. Optical spectroscopy methods: brief characteristic, physical basis and their application for nanomaterials analysis.
18. X-ray photoelectron spectroscopy (XPS) – principle of operation, explain why is a surface sensitive technique.
19. X-ray absorption spectroscopy (XAS) – explain the origin of the absorption coefficient fine structure observed in the extended energy range of XAS spectra.

20. Differences between classical and quantum-based methods of computational analysis of nanoscale systems.
21. The molecular dynamics (MD) method: principle of operation, advantages and limitations.
22. Periodic boundary conditions in computer simulation. Why and when are they used, how do they work, what are their main limitations?

Gdańsk, 07.11.2022

Dziekan
prof. dr hab. Józef E. Sienkiewicz
WYDZIAŁ FIZYKI TECHNICZNEJ
I MATEMATYKI STOSOWANEJ
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