

Final State Exams : BSP PI/specialization SSE

Final state exams include:

- Defense of bachelor thesis
- Presentation of written reports by the supervisor and at least one opponent with the proposals for classification of the work
- Oral part of the exam from one general subject and one subject of specialization (with possible choice).

For the study program **Physical Engineering, specialization SSE**, the general study subject is

Applied Physics

The subject of required selection of the specialization is then:

Structure and Physics of Solids

The subject ***Applied Physics*** of the state examination involves the following thematic areas:

1. Dynamics of a mass point – Newton’s laws of motion, Newton’s gravitation law, Galilei’s principle of relativity, one-dimensional motion, linear harmonic oscillator, mathematical pendulum.
2. Mechanics of a system of particles – impulse theorems, conservation laws, König’s theorem, two-body problem, Kepler’s problem.
3. Special theory of relativity – postulates of special relativity, Lorentz transformation, length contraction, time dilation, proper time, interval addition of velocities, Minkowski space-time, relativistic energy and momentum
4. Maxwell’s equations – integral and differential form of Maxwell’s equations in vacuum and material environment, laws of Gauss, Amper and Faraday, vector and scalar potential, Lorentz force
5. Electrostatic and magnetostatic fields – Coulomb’s law, electric intensity, energy of a system of charged particles, electrostatic potential, multipole expansion, electric dipole, polarization vector, magnetic dipole, magnetization vector, Biot-Savart’s law
6. Waves in dispersive and non-dispersive media – standing and travelling waves, energy and the density of energy flow for a string, wave equation, dispersion relations, wave packet and Fourier transformation, group and phase velocity, spherical and plane wave
7. Electromagnetic waves – plane electromagnetic wave, energy density, Poyntig’s vector, intensity, polarization, interference and diffraction.
8. Atomic physics – black body radiation, Planck’s hypothesis, photoeffect, de Broglie’s hypothesis
9. Thermodynamics – principles of thermodynamics, Maxwell’s relations and thermodynamical potentials, entropy, ideal gas and its properties, thermodynamical equilibrium.
10. Statistical physics – the most probable distribution, Maxwell’s distribution of velocities, canonical and grand canonical ensemble, partition sum, equipartition theorem

Obsah tohoto předmětu státních závěrečných zkoušek je dán povinnými předměty studijního programu:

02MECH Mechanics

02ELMA Electricity and Magnetism

02TER Heat and Molecular Physics

02VOAF Waves, Optics and Atomic Physics

02TSFA Thermodynamics and Statistical Physics

Examination questions of the subject **Structure and Physics of Solids** cover the following thematic areas::

1. Structure of solids - main types of bonds, bonding forces, atomic and ionic radii, coordination numbers, macroscopic symmetry of crystals, crystal lattice, polytype, isomorphism, polymorphism, solid solutions, interstitial compounds and intermediate phases, liquid crystals, nanocrystals, amorphous substances, structural defects, diffusion
2. Symmetry of crystals - groups of symmetry, reducible and irreducible representations of point groups of symmetry, properties of irreducible representations, decomposition of reducible group representations, tables of characters for point groups of symmetry, bases for irreducible representations of point groups of symmetry, direct product and its use, ligand and crystal field, selection rules for optical transitions
3. Mechanical properties of solids - elastic and plastic deformation, dislocation dynamics, ductility and strength of solids, tensor description of the relationship between symmetry and properties of crystals
4. Thermal vibrations of atoms in crystalline solids - acoustic and optical branches of vibration waves, phonons, thermal capacity, thermal expansion and thermal conductivity of a crystalline lattice
5. Electronic structure of solids - basic properties of wave functions and energy spectrum of electrons in periodic electric field of crystals
6. Physics of metals - model of free electrons, electrical, magnetic and thermal properties, superconductivity
7. Physics of dielectrics - orientational, ionic and electronic polarization, optical properties, ferroelectrics, phase transitions
8. Semiconductor physics - intrinsic and extrinsic semiconductors, electrical conductivity, Hall effect, contact phenomena, PN transitions, photoelectric properties, surface properties, transistors
9. Theoretical foundations of main experimental methods used in solids studies - X-ray, electron and neutron diffraction analysis, optical and Raman spectroscopy
10. Applications of diffraction methods - utilization of x-ray absorption, methods to study single crystals, powders and polycrystalline substances, phase analysis, tensometric and texture analysis.

Content of this state final examination subject is given by the following compulsory courses of the study program:

11ZFPL Elementary Solid State Physics

11MAPL Solid State Physics – Applications and Analytic Methods

11SPL Structure of Solids

11DAPL Diffraction Analysis of Solids

11APLG Application of Group Theory in Solid State Physics