

Topics for the State Doctoral Examination in Structural Biology

Structure of biomolecules

- Basic information about biomolecular structures (proteins, nucleic acids, saccharides)

Characterization of biomolecular structure

- X-ray crystallography (background, preparation of biopolymer crystals, process of crystallographic experiment, phase problem, refinement, data evaluation)
- Electron microscopy (technical background, sample preparation, 3D structure determination - single-particle reconstruction, cryo-electron tomography)
- Nuclear magnetic resonance (background, interaction of nuclei with magnetic field)
- Structure determination using NMR experiment)
- Mass spectrometry (MALDI MS fingerprinting, LC-MS for determination of protein sequence)
- Optical methods (UV/Vis spectrometry, circular dichroism, dynamic light scattering)
- Molecular modelling (basics of quantum mechanics, molecular mechanics)
- Comparison of methods for structure determination

Characterization of biomolecular interactions

- Methods used for detection of kinetics, steady-state and thermodynamics of interactions (e.g. Surface plasmon resonance, ELISA, isothermal titration calorimetry, AFM force spectroscopy, fluorescence-based techniques - fluorescent labelling of biomolecules, fluorescence anisotropy, Microscale thermophoresis, fluorescence microscopy, microarrays)

Protein preparation

- Basic approaches of molecular biology (cloning, PCR, mutagenesis)
- Production of proteins (preparation of recombinant proteins, protein tags, chromatography)
- Principles of protein and DNA electrophoresis