Nuclear chemistry

The lecture covers the following issues:

Stability of the atomic nucleus. Types of radioactive decays, α, β, γ, spontaneous fission, cluster decay of nuclei, proton emission. Laws of radioactive decay. Radioactivity, natural and artificial series. Nuclear reactions. Mechanism of nuclear reactions. Energy balance of nuclear reactions. Efficiency of nuclear reactions. Chemical effects of nuclear reactions. Excitation and recoil effects in gases, liquids and solids. Labeling compounds in recoil reactions. Influence of the chemical environment on the half-life. The Mössbauer effect. Specific chemical properties of radionuclides. Chemistry of a single atom and sets of elements up to 103. Radiocolloids. Radionuclides with high specific activity. Natural and artificial radioelements. Radionuclides in nuclear medicine. Diagnostic radiopharmaceuticals, targeted radionuclide therapy, neutron capture therapy (BNCT). Obtaining new elements in reactions with neutrons, protons, particles α and heavy ions. Specific chemical properties of the heaviest elements. Relativistic effects in chemistry and their effect on the chemical properties of heavy elements. The role of the 5f subshell. Chemical properties of actinites. Obtaining transactinides and chemical properties of elements from 104 to 118. Techniques used in the study of transactinides. Islands of stability and super-heavy elements. Prediction of the properties of 6*f* and 5*g* electron elements. Structure of the periodic table in the region of superheavy elements. Formation of elements in nature. The evolution of stars, the evolution of the earth, cosmic radiation. Activating methods of chemical analysis. Radioecology. Chemical aspects of nuclear energy. Chemistry of cooling circuits. Low, intermediate, and high-level waste from nuclear power plants. Processing of high-level waste. Purex, Sanex and Ganex processes. Separation of lanthanides from minor actinites. High-level radioactive waste as a source of valuable radionuclides (^{90}Sr, ^{106}Ru) and some platinum metals (Ru, Pd, Rh). Transmutation of long-lived radionuclides in mixed fuels and ADS reactors. Technologies for the concentration and solidification of radioactive waste.

The course will end final oral examination