Entrance exam program
in training of highly qualified personnel
(Ph.D. programme)
1.4 “CHEMICAL SCIENCES”

Entrance exam program for the postgraduate Ph.D. programme in training of highly qualified personnel 1.4 “CHEMICAL SCIENCES” includes the following sections:

"Analytical Chemistry"

The subject of analytical chemistry. Aims and features of analytical chemistry and analytical service. Analytical problems: detection, identification, determination of substances. Chemical, physical and biological methods of analytical chemistry. Types of chemical analysis: isotopic, atomic, structural-group (functional), molecular, material, phase. Macro-, micro-, ultramicroanalysis. Local, non-destructive, remote, continuous, out-of-laboratory (field) analysis. Methods of analysis. Chemical methods. Acid-base equilibrium. Complexation. Redox equilibrium. Precipitation-solution processes. Organic reagents in chemical analysis. Gravimetric methods. Titrimetric methods. Redox titration. Complexometric titration. Precipitation titration. Kinetic methods. Biochemical methods. Electrochemical methods. Potentiometry. Coulometry. Voltammetry. Conductometry. Physical methods. Methods of atomic optical spectroscopy. Atomic emission spectroscopy. Atomic absorption spectrometry. Atomic fluorescence spectroscopy. Methods of X-ray and electron spectroscopy. Methods of X-ray spectral analysis (XAS). Methods of molecular optical spectroscopy. Spectrophotometry. Luminescent methods. Infrared and Raman (Raman scattering) spectroscopy. Methods of mass spectrometry. Resonance spectroscopic methods. Nuclear physical and radiochemical methods. Activation analysis. Radiochemical methods: Methods for local analysis and surface analysis. Biological methods. Chromatographic methods. Gas chromatography. Gas-adsorption (gas-solid phase) chromatography. Gas liquid chromatography. High performance capillary gas chromatography. Supercritical fluid chromatography. Liquid chromatography. High performance liquid chromatography. Ion-exchange chromatography. Ion chromatography. Ion vapor chromatography. Exclusion chromatography. Affinity chromatography. Thin layer chromatography. Sorption methods. Extraction. Metrology and chemometrics. Metrological bases of chemical analysis. Computer methods in analytical chemistry. Automation of analysis. Analysis of specific objects. The analytical cycle and stages of analysis. Sampling and sample preparation. Basic objects.

Geological objects. Metals, alloys and products of the metallurgical industry. Materials of the nuclear industry. Inorganic substances. Organic substances. Biological and medical objects. Food products. Environmental objects.

Reference List:

1. Nanobiotechnology [Electronic resource] : workshop / edited by A. B. Rubin. - 2nd ed. (el.). - Moscow : BINOM. Lab. knowledge, 2013. - 401 p.

Tyukavkina N.A. Bioorganic Chemistry [Electronic resource] : textbook / N.A. Tyukavkina, Y.I. Baukov, S.E. Zurabyan. - Moscow : GEOTAR-Media, 2014. - 412 p.

3.Metal-binding proteins: structure, properties, functions [Text]. - Moscow : Nauchny Mir, 2012. - 541 p.