**MODERN ASPECTS OF THE APPLICATION OF ORGANIC COMPOUNDS**

1. GENERAL DESCRIPTION OF THE DISCIPLINE

The work programme of the discipline is compiled according to the Federal State Higher Professional Education Standards

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| --- | --- | --- | --- |
| Code of the field of study | Field of study | Details of the order of the Ministry of Education and Science of the Russian Federation on approval and commissioning of the Federal State Higher Educational Standard | |
| Date | Number of order |
| 04.06.01 | Chemical Sciences / Organic Chemistry | 30 July 2014 with amendments dated 30 April 2015 | 869  amendments  464 |

**Aims, objectives and place of the discipline in the educational activity structure**

The discipline *Modern Aspects of the Application of Organic Compounds* refers to Section B.1 of the elective part of the Principal Educational Programme of the postgraduate course.

The discipline aims: The discipline aims at shaping ideas about the modern organic materials in science and technology on modelling and design of molecular devices.

Studying the discipline involves accomplishing the following task.

- to generate a holistic view of the diversity of organic substances and materials, the relationship between the structure of organic compounds and their properties, the possibilities of their practical use in science and technology.

As a result of studying the course, a student should:

Know:

- actual problems of organic chemistry and chemical technology;

- effective methods for obtaining new organic substances and materials based on them;

- modern organic materials properties, features of their structure and functional parameters;

- the main areas of application of organic substances and materials based on them.

Be able:

- to use theoretical concepts of the structure and properties of organic substances in the directed synthesis of materials with specified properties;

- to use complex approaches in the field of synthetic, structural and applied organic chemistry to predict the properties of organic compounds and materials based on them;

- to use information resources to create new objects with useful properties;

- to use reference sources and attract new scientific literature from the Internet to solve interdisciplinary research tasks.

Master:

- the skills of using theoretical material to predict the properties of organic compounds based on their structure;

- the knowledge and practical skills in the field of synthetic organic chemistry and material sciences;

- the skills of working with scientific literature in order to determine the area of research and solve focused problems.

As a result of mastering this discipline, a postgraduate student should master the following competencies:

**General Professional Competences (GPC):**

* the ability to individually carry out research activities in the relevant professional field using up-to-date research methods as well as information and communication technologies (GPC-1);
* readiness to arrange for the work of a research team in the field of chemistry and related sciences (GPC-2).

**Professional Competencies (PC):**

**research activities:**

* the ability to individually carry out research work and obtain scientific outcomes that meet the established thesis content requirements for the PhD degree in the area of focus (scientific specialty) 02.00.03 Organic Chemistry (PС-1);
* the readiness to present scientific results on the thesis topic in the form of publications in peer-reviewed scientific publications, speeches at scientific conferences, review and edit scientific articles on the area of study (scientific specialty) 02.00.03 Organic Chemistry (PС-2).

**Study time structure and allocation**

Total work input for the discipline is 3 credits/ 108 hours

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Names of the disciplines that make up the module | Term | Amount of time allocated for mastering the module disciplines | | | | | | |
| In-class learning, hours | | | | Self-guided work, hours | Discipline attestation (test, exam) | Total,  hour/credit |
| Total | Lectures | Practical exercises  занятия | Laboratory work |
| Contemporary aspects of the use of organic compounds |  |  |  |  |  |  |  |  |
| 5 | 4 | 4 |  |  | 104 | зачет | 108/3 |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Mastering, total | | 4 | 4 |  |  | 104 |  | 108/3 |

**DISCIPLINE CONTENT**

|  |  |  |
| --- | --- | --- |
| No | Content | |
| Р1 | Use of organic compounds in industry | Synthesis of organic compounds in industry. Organic solvents. Process fluids. Hydraulic fluids and lubricating oils. Additives. Autocosmetics. |
| Р2 | Use of organic compounds in agriculture | Organic fertilizers. Pesticides. Bactericides. Herbicides. Insecticides. Fungicides. Acaricides. Zoocides. Repellents. |
| РЗ | Use of organic compounds in everyday life and human life | Polymers and polymeric materials. Plastics, synthetic rubber and rubber. Polyelectrolytes, ion exchangers. Optical and photographic materials. Organic semi-conductors and synthetic metals. Paint and varnish materials, optical brighteners. Composite materials. Surface-active substances. Synthetic fragrance substances. Cosmetic chemistry fundamentals. |
| Р4 | Use of organic compounds in medicine | Pharmaceuticals. Types of medicines. Classification of medicinal substances. The physical and chemical properties of biologically active substances, design of medicinal compounds. Pharmacokinetics and pharmacodynamics. Design of medicinal compounds by the example of different classes of physiologically active substances. Enzymes, coenzymes. Vitamins. |
| Р5 | Products of organic synthesis in nanochemistry and nanotechnology | Methods for obtaining and studying nanoparticles. Types of nanoparticles. Organic macrocycles. Catenanes and related structures. Dendrimers. Fullerenes and other nanoparticles. Ensembles. Use of nanotechnology. New materials. Biology and medicine. Environmental protection in catalysis. New sources of electric current. Nano-sized instruments and devices. Nanoelectronics and molecular computers. Nanochemistry and nanotechnology on the Internet |
| Р6 | Use of organic compounds in supramolecular chemistry | Supramolecular chemistry. Definition. The features of the electronic structure of materials. Binding of cations and anions. Crystal engineering. Templates and self-assembly. Design, modelling and production of molecular machines and molecular devices. Biomimetics. Liquid interface, liquid crystals and liquid clathrates. Applied aspects. |
| Р7 | Other applications of organic substances | Metal corrosion inhibitors. Flotation and flotation reagents. Emulsion polymerisation and emulsifiers. Interphase catalysis. Complexing agents. The chemical sources of current and organic electrolytes. Explosives and pyrotechnic compounds. Poisoning substances and their destruction |

**3. DISTRIBUTION OF THE DISCIPLINE EDUCATIONAL TIME VOLUME BY TOPIC AND WORK TYPE**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code of section, topic | Discipline section, topic | | Amount of study time allocated for mastering the discipline, credit/hour | | | | | | | |
| In-class learning | | | | | | Self-guided work | Section, total |
| total | | including lectures | | including seminar/ practical exercises | Including laboratory work |
| Р1 | Use of organic compounds in industry | | 1 | | 1 | |  |  | 16 | 17 |
| Р2 | Use of organic compounds in agriculture | | 1 | | 1 | |  |  | 20 | 21 |
| РЗ | Use of organic compounds in everyday life and human life | | 1 | | 1 | |  |  | 16 | 17 |
| Р4 | Use of organic compounds in medicine | | 1 | | 1 | |  |  | 16 | 17 |
| Р5 | Products of organic synthesis in nanochemistry and nanotechnology | |  | |  | |  |  | 16 | 16 |
| Р6 | Use of organic compounds in supramolecular chemistry | |  | |  | |  |  | 10 | 10 |
| Р7 | Other applications of organic substances | |  | |  | |  |  | 10 | 10 |
| Discipline, total | | | 4 | | 4 | |  | |  | 104 | 108 |

**4. DISCIPLINE LEARNING OUTCOME REQUIREMENTS**

An objective assessment of the level of compliance of the learning outcomes with the educational programme learning requirements is secured by a set of developed criteria (indicators) for assessing the knowledge acquisition, skills development and experience in performing the professional tasks.

|  |  |  |  |
| --- | --- | --- | --- |
| Competence components | Features of the level of mastering competence components | | |
| threshold level | higher level | high level |
| Knowledge | A post-graduate student demonstrates the acquaintance knowledge, copy knowledge, i.e. recognises objects, phenomena and concepts, finds some differences in them, shows the knowledge of the sources of information, can independently carry out reproductive actions on knowledge by self-reproduction and application of the information. | A post-graduate student demonstrates the analytical knowledge, i.e. confidently reproduces and understands the acquired knowledge, assigns them to one or another classification group, independently arranges them, establishes interrelations between them and effectively applies them in familiar situations. | A post-graduate student can independently obtain new knowledge from the surrounding world and creatively use it to make decisions in new and unusual situations. |
| Skills | A post-graduate student is capable of correctly performing the prescribed actions following the instructions and/or an algorithm in a known situation, independently performing actions to address typical issues that require a choice from among the known methods, in predictably changing situations | A post-graduate student is capable of independently performing the actions (techniques, operations) to solve non-standard problems that require selection based on a combination of known methods, in an unpredictably changing situation | A post-graduate student is capable of independently performing the actions associated with solving research problems, demonstrates the creative use of skills (technologies) |
| Personal qualities | A post-graduate student has a low learning motivation, shows an indifferent, irresponsible attitude to studying and/or the assigned task. | A post-graduate student has a pronounced learning motivation and demonstrates a positive attitude towards learning and future activities, and is active. | A post-graduate student has a developed motivation for training and work, shows perseverance and enthusiasm, hard work, independence and creativity. |

**5. APPRAISAL TOOLS TO ENSURE THAT THE ACADEMIC PROGRESS CAN BE REGULARLY MONITORED AND INTERMEDIATE ATTESTATION CONDUCTED**

**The list of test questions (the verifiable competences General Professional Competence-1, General Professional Competence-2, Professional Competence-1, Professional Competence-2)**

* Use of organic compounds in industry. Organic solvents.
* Use of organic compounds in agriculture. Organic fertilizers. Pesticides. Bactericides. Herbicides.
* Use of organic compounds in agriculture. Insecticides. Fungicides. Acaricides. Zoocides. Repellents.
* Polymers and polymeric materials.
* Plastics, synthetic rubber and rubber.
* Surfactants.
* Synthetic fragrances.
* Classification of medicinal substances.
* Design of medicinal compounds.
* Enzymes, coenzymes.
* Vitamins.
* Organic macrocycles.
* Nanoelectronics and molecular computers.
* Supramolecular chemistry.
* Chemical sources of current and organic electrolytes. Explosives and pyrotechnic compounds.
* Poisoning organic substances and their utilisation.

**Electronic educational resources**

Zonal scientific library http://lib.urfu.ru

Library Catalogues http://lib.urfu.ru/course/view.php7icK76

Electronic catalogue http://opac.urfu.ai

Electronic-library systems http://hb.urfu.ru/mod/resource/view.php7idX2330

Electronic resources of free access http://lib.urfu.ru/course/view.php?id=75

Electronic resources by subscription http: //lib.urfu.ш/mod/data/view.php? Id = 1379

**Databases, information, reference and search systems**

ScienceDirect: http://www.sciencedirect.com;

Web of Science: http://apps.webofknowledge.com;

Scopus: http://www.scopus.com;

Reaxys: http://reaxys.com

Search system EBSCO Discovery Service http://lib.urfu.ru/course/view.php7idM41

Federal Institute of Industrial Property http: // wwwl .fips.ru

Intellectual search system Nigma.RF. Available at http://www.nigma.ru