MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
National Research
TOMSK STATE UNIVERSITY

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| APPROVED BY<br>Rector<br>_____E.V. Galazhinskiy<br>_____20_____ |
| Registration number of the Programme<br>_____ |

# BASIC EDUCATIONAL PROGRAMME OF HIGHER EDUCATION

subject area

03.04.02 Physics

Specialty (profile):

PHYSICS METHODS AND INFORMATION TECHNOLOGIES IN BIOMEDICINE

Degree:

Master of Science

Mode of study

Full-time

Tomsk – 2016

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**1. General provisions**

1.1 Basic Educational Programme (BEP) of the Master's Programme delivered by National Research Tomsk State University (TSU) in subject area 03.04.02 Physics and profile *Physics Methods and Information Technologies in Biomedicine* is a system of documents developed and approved by the University in accordance with the Regulations of TSU on Basic Educational Programme of Higher Education in view of the labour market demand. The Programme is based on the Federal State Educational Standard of Higher Education (FSES HE) and takes into account the recommended model of a basic educational programme.

The BEP is a set of general features of learning process (workload, content, and outcome), organisational and pedagogical conditions, and forms of assessment. The set is represented as an overview of the educational programme, curriculum, academic calendar, syllabi of disciplines (modules), programmes of practical trainings, assessment tools, teaching and learning materials, and other components included into the educational programme by decision of the institution.

The Basic Educational Programme relies on the Agreement with Siberian State Medical Univetisity (SibSMU) No5404 dated 1 September 2015; Agreement with Maastricht University (UM) (Agreement on Cooperation in Education and Science dated 5 December 2012) with supplements (Supplement 1 to the Agreement on Cooperation in Education and Science dated 24 May 2013; Supplement 2 to the Agreement on Cooperation in Education and Science dated 16 December 2014), and Agreement with Transnational University of Limburg, Maastricht University (the Netherlands) dated 2 July 2015.

1.2 The BEP of the Master's Programme relies on the following laws and regulations:

– Federal Law No273-FZ *On Education in the Russian Federation* dated 29 December 2012 (ed. 2 March 2016);

– Decree of the Ministry of Education and Science of the Russian Federation No1623 dated 11 April 2001 *On Minimum Standards for Availability of Learning Materials at Universities Concerning the Library and Information Resources* (ed. Decree of the Ministry of Education and Science of the Russian Federation No133 dated 23 April 2008);

– Organisation and delivery of educational activity in Bachelor's, Specialist's, and Master's Programmes (approved by Decree of the Ministry of Education and Science of the Russian Federation No1367 dated 19 December 2013);

– Decree of the Ministry of Education and Science of the Russian Federation *On the Approval of the List of Specialties and Subject Areas in Higher Education* No1061 dated 12 September 2013;

– Federal State Educational Standard in subject area 03.04.02 Physics (Master's) No913 approved by Decree of the Ministry of Education and Science of the Russian Federation dated 28 August 2015;

– Procedure of Final State Examination in Bachelor's, Specialist's, Master's Programmes approved by Decree of the Ministry of Education and Science of the Russian Federation No636 dated 29 June 2015 (in editions of Decrees of the Ministry of Education and Science of the Russian Federation No86 dated 9 February 2016 and No502 dated 28 April 2016);

– The Statute of Federal State Autonomous Educational Institution of Higher Education National Research Tomsk State University;

– local acts.

## 2. Educational standard in the subject area

The structure and content of the BEP *Physics Methods and Information Technologies in Biomedicine* comply with the Federal State Educational Standard of Higher Education in subject area 03.04.02 Physics (Master's) approved by Decree of the Ministry of Education and Science of the Russian Federation No913 dated 28 August 2015 (Annex 1).

## 3. Overview of the Basic Educational Programme

Currently, physics methods involving laser radiation, X-ray apparatus, computed tomography, MRI, and methods and tools of nuclear medicine are widely used in medicine for treatment and diagnosis. Complex electronic equipment is becoming more popular, for example different types of accelerators, thermal imaging cameras, EEG devices. Advanced information technologies and high-performance computing systems are implemented to process multidimensional data. Consequently, applied medicine and research institutions need specialists trained in physics, mathematics, electronics, computer science and understanding medical tasks.

On the other hand, fast development of knowledge in such spheres as virology, bacteriology, immunology, oncology, genetic engineering, and genetic therapy is accompanied by increasing attention to the influence of environment on human health. Biophysics, bioelectronics, and nanotechnologies provide great opportunities for developing new medicine, screening methods, and highly sensitive biosensors.

The Master's Programme allows students to gain knowledge in modern physics, information technologies, and biomedicine and helps them to broaden their understanding and improve their professional skills in natural sciences.

Of great importance is the application of physics concepts and modern physics methods and techniques, devices, and technologies to do research into human body and enhance the quality of diagnosis, prevention, and treatment.

In accordance with the labour market demand, the Master's Programme is aimed at training highly qualified specialists who have knowledge in medical physics and bioinformatics and can understand physical nature of processes occurring in a living body and assess the influence of physical factors on biological objects, work with high-technological medical and diagnostic equipment and apply latest technologies to diagnosis and treatment.

The goals of the Programme are consistent with the mission of Tomsk State University, requirements of the Federal State Educational Standard of Higher Education in the subject area, and with the interests of employers and other consumers of educational services (government, parents, educational institutions, etc.).

Factors contributing to achieving the goals:

– development of partnership with overseas and domestic universities, research and scientific institutions, and medical institutions;

– academic mobility of lecturers and students;

– enhancement of intellectual activity and application of results in enterprises/organisations.

### 3.1 Entry requirements

Candidates with Bachelor's or Specialist's Degree applying for the Master's Programme are enrolled according to the results of entrance examination.

One of the main requirements is proficiency in English (B1-B2 according to the Common European Framework of Reference for Languages (CEFR)).

Entrance Examination Programme consists of a written exam in Physics and interview on the profile of the Programme allowing assessment of applicants' skills and knowledge to study on the Master's Programme.

Written exam in Physics is held in Russian, interview on the profile of the Programme is held in English. Entrance examination for overseas applicants is held in English. Video conferencing is available.

### 3.2 Time limit for programme completion

All requirements for the Master's Degree must be completed within a two-year time period.

### 3.3 Workload

The workload of the BEP is 120 ECTS.

### 3.4 Awarded qualification

Graduates of the Master's Programme are awarded a Master's Degree.

### 3.5 Overview of graduates' professional activity

#### 3.5.1 Spheres of graduates' professional activity

Spheres of graduates' professional activity involve studying structures and properties of nature at different levels from elementary particles to the Universe, fields and phenomena making up the fundamentals of physics, exploring new methods for researching basic laws of nature, all types of physical phenomena that can be observed in nature, processes and structures in public and private research and scientific centers and manufactures solving physics tasks, in higher education institutions and vocational institutions, and secondary schools.

Graduates have professional competencies to perform practical and scientific activity dealing with the development and implementation of physics research methods and information technologies into biology and medicine to improve the quality of medical care and effective use of health care resources.

Graduates of the Master's Programme can work in such institutions and enterprises as:

– institutions under the Ministry of Health Care of the Russian Federation;

– academic and departmental research and scientific institutions solving physics, medical, and biological tasks;

– medical and biological centres, other institutions of health care system;

– institutions of higher and vocational education.

#### 3.5.2 Objects of graduates' professional activity

In accordance with the Federal State Educational Standard of Higher Education in the subject area, the objects of graduates' professional activity are physical systems of different scale and levels of organisation, their functioning; research and methods for studying biological objects, physical, engineering and physical, biophysical, chemical and physical, medical and physical, and environment protection technologies; physical examination and monitoring.

Specifics of the objects of professional activity in view of the training profile is determined by studies using systems of measurement, control, and diagnosis of living objects, systems allowing modelling and experimental studies of processes occurring in a body.

### 3.5.3 Types of graduates' professional activity

In accordance with the Federal State Educational Standard of Higher Education in the subject area and profile of the Master's Programme, types of professional activity of a Master's Student are research and science, and management.

Graduates of the Programme in accordance with the types of professional activity are prepared to solve the following tasks:

in research and science:

- to carry out research into identified problems;
- to select relevant research methods;
- to formulate new tasks emerged in the course of research;
- to work with scientific literature using new information technologies and monitor publications;
- to select technological means, prepare equipment, work with experimental physical facilities;

in organisation and management:

- to participate in research, scientific, and innovative work, monitor compliance with the safety rules;
- to write reviews and scientific papers;
- to prepare bids for grants and design research and technological projects, reports, and patents;
- to organise infrastructure of an enterprise, including the information and technological one.

### 3.6 Specialty (profile)

The Profile of the Programme specifies the use of physics methods, computing tools, information and supercomputer technologies to solve practical and theoretical tasks in medicical physics and biomedicine, including:

– selection of an optimal method and programme of research, modification of current methods and development of the new ones according to the tasks within a particular study;

– measurement and experimental study of properties and parameters of medical equipment to upgrade and create new devices and technologies;

– mathematical modelling of developed structures, devices, or technological processes to improve their parameters;

– use of typical software and development of new software packages solving the tasks in medicine and biology;

– arrangement of modelling and field experiments on optimization of structures and constructions of studied technologies and devises;

– analysis of scientific and practical significance of research;

– preparation of research results for scientific papers, reviews, reports, and presentations;

– physical analysis of a scientific and technological problem, formulation of a medical and technological assignment, setting goals and tasks of research into the object based on selection and study of the literature and patent sources;

– analysis, systematisation, and summary of scientific and technological data on the research topic;

– bibliographic and patent search by means of the latest information technologies.

**3.7 Learning outcomes**

In accordance with the goals of the BEP and tasks in professional activity specified by the Federal State Educational Standard of Higher Education in the subject area, graduates in subject area 03.04.02 Physics must have the following competencies:

**General competencies (GC):**

– ability for abstract thinking, analysis and synthesis (GC-1);

– ability to act in unusual situations and bear ethical and social responsibility for decisions (GC-2);

– ability for self-development, self-realisation and use of creative potential (GC-3).

**General professional competencies (GPC):**

– ability to communicate both orally and through the written word in the official language of the Russian Federation and other languages to solve the problems of professional activity (GPC-1);

– ability to guide a team in their professional activity being tolerant of social, ethnic, confessional and cultural differences (GPC-2);

– ability for social mobility and organisation of research and innovative works (GPC-3);

– ability to adapt to a new scientific field of professional activity, sociocultural and social conditions of the activity (GPC-4);

– ability to use professionally-oriented knowledge and computer technologies to solve professional tasks including those that are not related to the major (profile) of a training (GPC-5);

– ability to apply knowledge of modern problems and latest achievements in physics to research work (GPC-6);

– ability to demonstrate knowledge of philosophical issues in natural science, history and methodology of physics (GPC-7).

Graduates completing the Master's Programme must have professional competencies relevant to the types of professional activity the Programme is oriented to:

research and scientific activity:

– ability to identify specific tasks of physics studies and solve them by means of modern equipment and information technologies based on domestic and international experience (PC-1);

organisational and managerial activity:

– ability to plan and organise physics studies, scientific seminars and conferences (PC-4);

– ability to use skills in designing technical documentation, reports, reviews, papers and articles (PC-5).

According to the specialty of the Programme, the set of competencies is added with some special professional competencies (SPC):

– understanding of the basic neurology, the fundamentals and practice of medical diagnosis and therapy (SPC-1);

– knowledge of basics of gene regulation, the fundamentals and practice of molecular diagnosis and therapy (SPC-2);

– knowledge of the main methods to determine molecular targets and their applications in biomedical diagnosis (SPC-3);

– knowledge of the ethical and legal issues of care and use of laboratory animals, physiological features of laboratory animals (SPC-4);

– understanding of the fundamentals of biosafety, regulations and guidelines (SPC-5);

– ability to use software for statistical analysis of multidimensional biomedical data in evaluation of the state of biosystems (SPC-6);

– experience in creating models of diseases with laboratory animals and composing a detailed experimental protocol (SPC-7);

– practical skills at obeying safety rules in a potentially hazardous laboratory environment (SPC-8).

Matrix and maps of the developed competencies are provided in Annex 3.

Learning outcomes meet the demands of labour market taking into account its changes, development of science and technology, information systems and technologies, new knowledge in biology and medicine, and biomedicine.

The content of the Programme and training objectives are reviewed in accordance with the requirements of legal and strategic documents, federal and regional programmes and are reflected in the minutes of meetings of the departments and faculty.

The mechanism of updating and adjusting the Programme in accordance with the demand of labour market is also provided by the Regulations on Basic Educational Programme in National Research Tomsk State University (http://tsu.ru/upload/medialibrary/fb5/584_od.pdf).

### 3.8 Academic faculty

The Master's Programme is delivered by management and academic faculty of the organisation along with the parties involved into the Master's Programme according to civil contract.

A share of the academic faculty (given integer values of rates) having education relevant to the profile of a taught discipline (module) of the total number of the academic faculty delivering the Master's Programme is 100%.

A share of the academic faculty (given integer values of rates) having an academic degree (including degrees awarded abroad and recognised in the Russian Federation) and (or) academic title (including academic titles awarded abroad and recognized in the Russian Federation) of the total number of the academic faculty delivering the Master's Programme is 91.4%.

A share of the academic faculty (given integer values of rates) of a total number of managers and employees of organisations whose activity is related to the profile of the Master's Programme (working experience in professional sphere more than 3 years) of the total number of the academic faculty delivering the Master's Programme is 29.9%.

Since the start of the Master's Programme the average annual number of publications per 100 academic faculty members (given integer values of rates) is 231.9 papers in journals indexed in the databases of Web of Science or Scopus and 481.45 papers in journals indexed in the Russian Science Citation Index (RSCI).

Director of the Master's Programme is a full time academic faculty member of NR TSU Vladimir Demkin, Doctor of Physics and Mathematics, Professor, Head of the Department of General and Experimental Physics at the Faculty of Physics, a correspondent member of the Russian Academy of Natural Sciences, a member of the International Informatization Academy, Laureate of the Prize of the President of the Russian Federation in Education (43 years of pedagogical experience). He has more than 90 publications in international and domestic journals, among them 22 publications for the last five years. Hirsh index is 14 in the database of the Russian Scientific Citation Index, 3 in the database of Web of Science, and 3 in the database of Scopus. He has presented research results on more than 40 national and international conferences. He has been a Head and Chief Executive of over 13 projects and grants of the Ministry of Educationa and Science of the Russian Federation, Russian Humanitarian Scientific Fund, and National Training Fund.

Qualification training within the Master's Programme is provided by lecturers at the Faculty of Physics, Faculty of Mechanics and Mathematics, Institute of Biology at TSU, and the Faculty of Medicine and Biology and Faculty of Medicine at SSMU. Disciplines *Computing in biomedicine, Current methodology and innovative research in diagnosis, prevention and therapy of disease, Physical fields and forces in biological systems*, and *Animal models in research* are taught with the engagement of employees and employers of partner organisations (Laboratory for Modelling of Physical Processes in Biology and Medicine (TSU); Research Institute of Biological Medicine (Altay State University); Centre for Multiple Sclerosis (SSMU); Laboratory for Electrosurgery (SSMU), POLIAR Ltd.) which represent an actual segment of the labour market.

The academic faculty have working experience and internships at European universities, participate in numerous conferences and seminars including those held abroad (Switzerland, the Netherlands, Great Britain, Hungary, the USA, and others). The faculty members have their own research and scientific projects in the subject area; they annually publish the results of their

research and scientific activity in domestic and international peer-reviewed scientific journals and periodicals; they also present the results of their research and scientific activity at national and international conferences.

**3.9 Language of instruction**

Master's Programme *Physics Methods and Information Technologies in Biomedicine* in subject area 03.04.02 Physics is taught in English.

**4. Curriculum**

See Annex 2.

**5. Competencies**

See Annex 3.

**6. Academic Calendar**

See Annex 4.

**7. Syllabi**

**7.1 Syllabi of disciplines (modules)**

See Annex 5.

**7.2 Programmes of practical trainings**

See Annex 6.

**8. Final State Examination**

See Annex 7.

**9. Assessment tools**

See Annex 8.

**10. Quality assurance**

The BEP of Master's Programme *Physics Methods and Information Technologies in Biomedicine* provides obligatory regular monitoring of the quality of taught disciplines and students' satisfaction with the learning process.

Quality control and assurance are based on the following procedures.

*Assessment of students' satisfaction with the learning process*

To control and improve the quality of teaching, students fill in Students' Satisfaction Questionnaire based on the principles of voluntarism and anonymity. The Questionnaire helps to assess their satisfaction with the learning process, teaching and learning materials, technological support of the disciplines, quality of lectures, forms of research, and others.

The questionnaire is held annually by a coordinator of the Programme. Respondents are senior students. Results are presented in the report that reveals strengths and weaknesses of the educational programme. The coordinator submits the report to the department to eliminate the deficiencies. Results are discussed at the meetings of the department to find out measures to enhance the quality of teaching and learning within the Programme:

- review of the content of a course;
- review of teaching methods and forms of learning;
- review of mid-term assessment;
- substitution of a course with the alternative one;

– other.

*Students' satisfaction with the learning conditions at University*

TSU Quality Management Centre conducts a survey at the end of each semester to get a comprehensive assessment of educational services from students' perspectives and to assess students' satisfaction with:

– the University and quality of work of university departments;

– the Faculty and quality of work of administration;

– infrastructure and quality of material and technological support of the learning process;

– quality of the educational programme and its components;

– developed competencies and skills.

The questionnaire is anonymous. Results are processed by the Quality Management Centre which submits an analytical report to the coordinator of the Programme. Heads of relevant departments are informed on the results of quality assessment. The information on degree of satisfaction with the quality of the educational programme can contribute to the development of infrastructure at the Faculty and improvement of separate components of the educational programme. Results of all procedures of quality assessment and relevant changes to the Programme improving its quality are reported to students, lecturers, heads of departments, dean. Information is discussed at the meetings with Master's Students, at the meetings of the department, at the meetings of Teaching and Learning Committee of the Faculty.

*Employers' satisfaction with graduates' training*

TSU Department of Internship and Employment takes part in monitoring employers' satisfaction with the level of graduates' training. They develop a system of cooperation between the University and strategic partners.

Research objectives:

– to identify factors contributing to the cooperation between TSU and employers in terms of employment;

– to identify degree of employers' satisfaction with the quality of training of TSU graduates;

– to identify the main requirements for future employees;

– to identify preparedness of partners' for further cooperation in training and employment of TSU graduates and reveal promising forms of cooperation from employers' perspective.

Research results are processed by the Department of Internship and Employment. The report provides a comprehensive view on advantages and disadvantages of training at the Faculty. It helps to develop forms of promising interaction between the Faculty and partner enterprises to enhance graduates' competitiveness and their employment according to the major. Results are discussed at the meetings of the department and Teaching and Learning Committee of the Faculty. Minutes record changes in the structure, content of the BEP, syllabi of disciplines, programmes of practical trainings, and forms of research.

Director of the Programme V.P. Demkin

AGREED WITH
Vice-Rector for Academic Affairs V.V.Dyomin