MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
NATIONAL RESEARCH
TOMSK STATE UNIVERSITY

FACULTY OF PHYSICS

APPROVED BY

Dean of the Faculty of Physics

_____O. N. Tchaykovskaya

01 09 2016

Programme of Practical Training

Pre-graduation practice

subject area

03.04.02 Physics

Profile

Physics Methods and Information Technologies in Biomedicine

Degree

Master of Science

Mode of study

Full-time

Tomsk-2016

1. Objectives of practical training

Pre-graduation practice aims to obtain theoretical and practical results sufficient for successful completion of a Master's Thesis (FQP) and its defence.

Completion of the programme of pre-graduation practice reveals the level of master's students' skills in relation to the types of activity the Master's Programme is oriented to.

2. Tasks in practical training

Tasks in pre-graduation practice are as follows:

- to deepen and broaden acquired knowledge;
- to strengthen competencies related to the profile of the Programme;
- to collect and process experimental and empirical data;
- to develop analytical and organisational skills;
- to prepare and write Master's Thesis.

3. Integration of practical training into the structure of the BEP

Pre-graduation practice is included in optional part of Study block 2. Practices, including research of the curriculum and is obligatory for preparing Master's Thesis.

Pre-graduation practice takes place in the fourth semester and is one of the final stages of a Master's Degree.

4. Types of practical training

Pre-graduation practice is a university-based practical training.

5. Forms of practical training

Pre-graduation practice is a laboratory practice.

6. Places and terms of practical training

Pre-graduation practice can be held in the Laboratory of General and Experimental Physics at TSU and laboratories of partner universities (Maastricht University, Siberian State Medical University).

Terms of completion are determined by the curriculum. Pre-graduation practice takes place in the fourth semester (33-40 weeks).

7. Learning outcomes of the practical training correlated with the learning outcomes of the BEP

Developed competencies	Learning outcomes
GC-1, level II ability for abstract thinking, analysis and synthesis	M (GC-1) –II MASTER skills at processing information, assessing personal knowledge and general culture within the context of social processes and setting goals of individual intellectual development
GC-2, level II ability to act in unusual situations and bear ethical and social responsibility for decisions	M (GC-2) – II MASTER methods for arranging and conducting activities in professional sphere based on moral values and legal standards accepted in the society
GC -3, level II ability for self-development, self-realization and use of creative potential	M (GC-3) – II MASTER skills at comparing personal experience and possibilities with achievements in professional and social spheres
GPC-1, level II ability to communicate both orally and through the written word in the official	M (GPC-1) –II MASTER skills at oral presentation and defence of research results

language of the Russian Federation and other languages to solve the problems of professional activity	
GPC-2, level I ability to guide a team in their professional activity being tolerant of social, ethnic, confessional and cultural differences	M (GPC-2) –I MASTER basics of team work, project management, and methods for influencing a team
GPC-3, level I ability for social mobility and organization of research and innovative works	M (GPC-3) –I MASTER techniques and technologies for estimating solutions to professional tasks
GPC-4, level I ability to adapt to a new scientific field of professional activity, sociocultural and social conditions of the activity	M (GPC-4) –I MASTER modern effective means of analysis of scientific and production activities
GPC-5, level II 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	M (GPC-5) –II MASTER methods and means for obtaining, storing, processing, and translating information by means of the latest information technologies including global computer networks
GPC-6, level II ability to apply knowledge of modern problems and latest achievements in physics to research work	M (GPC-6) –II MASTER methodology of research and scientific and practical activity, skills at developing competencies and knowledge
PC-1, level II 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	M (PC-1) – II MASTER methods for processing research strategies in a particular branch of physics
PC-4, level II ability to plan and organize physics studies, scientific seminars and conferences	M (PC-4) – I MASTER skills at developing organisational and managerial decisions, analysing consequences, and assessing effectiveness
PC-5, level II ability to use skills in designing technical documentation, reports, reviews, papers and articles	C (PC-5) –II CAN present information clearly and use it relevantly M (PC-5) – II MASTER skills at analytical processing of information
SPC-1, level I understanding of the basic neurology, the fundamentals and practice of medical diagnosis and therapy	M (SPC-1) – I MASTER fundamental and applied methods of medical diagnosis and therapy
SPC-2, level I knowledge of basics of gene regulation, the fundamentals and practice of molecular diagnosis and therapy	M (SPC-2) – I MASTER molecular diagnosis and therapy
SPC-3, level I knowledge of the main methods to determine molecular targets and their applications in biomedical diagnosis	M (SPC-3) – I MASTER techniques and technologies for evaluating results of research based on methods of determination of a molecular structure and microenvironment

SPC-6, level II ability to use software for statistical analysis of multidimensional biomedical data in evaluation of the state of biosystems	C(SPC-6) –II CAN conduct statistical processing of medical and biological data when solving tasks in biomedical studies M (SPC-6) – II MASTER basic skills and techniques of research for planning and statistical analysis of results of biomedical studies
SPC-8, level I practical skills at obeying safety rules in a potentially hazardous laboratory environment	M (SPC-8) – I MASTER techniques for identifying particular biological risks when working with biological objects

8. Workload of the practical training is 12 ECTS-Credits.

9. Pre-graduation practical training lasts 432 academic hours.

10. Content of the practical training

No	Sections (stages)	Types of work including independent work of postgraduate students and workload (in hours)		Forms of formal control
		Individual tutorials	Students' independent work	
1.	Processing and analysis of research results: – selection and systematisation of results; – processing, analysis, assessment of the effectiveness of results; – preparation of the text of a Master's Thesis; – submission of results to research supervisor.	72	144	Reports at scientific seminars
2.	Reporting: preparation of reporting documents on the results of pre-graduation practical training	72	144	Report as pre-defence of the Master's Thesis at the meeting of the Department Reporting documents: – Master's Thesis; – presentation of the results of a Master's Thesis.
	Total	144	288	

Results of pre-graduation practice can be presented as a report at a scientific conference/seminar, publication in a scientific journal indexed in the databases of Web of Science and Scopus.

11. Forms of reporting

Director of the Master's Programme is responsible for arrangement and control over pre-graduation practice. Research supervisor(s) take(s) control over mid-term and final results of pre-graduation practice.

Mid-term results of pre-graduation practice are presented at scientific.

Final results of pre-graduation practice are presented at the meeting of the Department as pre-defence of the Master's Thesis. Videoconferencing/webinar is available. Results of examination are awarded pass or fail. Research supervisor submits a reference letter which represents observations of arrangements of a Master's Student's work, assessment of completion of research tasks, and opinion on overall preparedness of the Master's Student for presenting a final version of his/her Master's Thesis at the defence.

Decision of the Department indicates preparedness of the Master's Student for the defence of the Master's Thesis and provides recommendations to improve organisation and holding of pre-graduation practice.

12. Assessment tools for mid-term assessment of Master's Students' progress in pre-graduation practical training (see Assessment Tools for Practical Training)

13. Teaching and learning materials and information support of practical training

a) main references:

1. Gerasimov B., Drobysheva V. Osnovy nauchnykh issledovanij [Fundamentals of research]. Moscow. – 2015. – 272 p. [RUS]

2. Mokij V., Nikiforov A. Metodologija nauchnykh issledovanij [Methodology of research]. Moscow. – 2016. – 255 p. [RUS]

3. Shashenkova E.A. Issledovatelskaja dejatel'nost' [Research activity]. Moscow: Perspektiva. – 2010. – 88 p. [RUS]

4. Protsess podgotovki, razrabotki, napisanija i oformlenija vypusknykh kvalifikatsionnykh rabot (VKR): urovni podgotovki: bakalavr, magistr, spetsialist: po raznym napravlenijam podgotovki [Preparing, developing, writing, and designing theses (FQP): Bachelor's, Master's, Specialist's Degrees in different subject areas]. Tomsk State University, Academic Office, Department of Standardization, Metrology, and Quality Control of R&D. A.S. Revushking, I.V. Ivonin. Tomsk. – 2014. [RUS]

5. Chen C. Searching for intellectual turning points: Progressive knowledge domain visualization [Electronic resource] // Proceedings of the National academy of sciences of the United States of America. – 2004. – Vol. 101, suppl. 1. – P. 5303–5310. – The electronic version of the printing publication. – URL: http://www.pnas.org/content/101/suppl_1/5303.full.pdf (access date: 22.11.2016).

6. Regehr G. Trends in medical education research [Electronic resource]// Academic medicine. – 2004. – Vol 79, is. 10. – P. 939–947. – Electronic version of printing publication. – URL : http://journals.lww.com/academicmedicine/Fulltext/2004/10000/Trends_in_Medical_Education_Research.8.aspx

b) additional references:

7. Blackford S. Career planning for research bioscientist [Electronic resource] / S. Blackford. – Chichester: Wiley, 2012. – 194 p. – The electronic version of the printing publication. – URL: https://ebookcentral.proquest.com/lib/tomskuniv-ebooks/detail.action?docID=1022741 (access date: 22.11.2016).

8. The institution of science and the science of institutions : the legacy of Joseph Ben-David / ed. by M. Herbst. – Dordrecht : Springer Science+Business Media, 2014. – (Boston

Studies in the Philosophy and History of Science). – Electronic version of printing publication. – URL: http://link.springer.com/book/10.1007/978-94-007-7407-0 (access date: 25.11.2016).

9. Minguillo D. Toward a new way of mapping scientific fields: authors' competence for publishing in scholarly journals [Electronic resource] // Journal of the Association for Information Science and Technology. – 2010. – Vol. 61, is. 4. – P. 772–786. – The electronic version of the printing publication. – URL: http://onlinelibrary.wiley.com/doi/10.1002/asi.21282/full (access date: 22.11.2016).

10. Hyland K. Scientific writing [Electronic resource] / K. Hyland, F. Salager-Meyer // Annual review of information science and technology. – 2008. – Vol. 42. – P. 297–338. – The electronic version of the printing publication. – URL: http://onlinelibrary.wiley.com/doi/10.1002/aris.2008.1440420114/pdf (access date: 22.11.2016).

11. Baker D. P. Teamwork as an essèntial component of high-reliability organizations [Electronic resource] / D. P. Baker, R. Day, Eduardo Salas // Health Research and Educational Trust. – Vol. 41, is. 4p2. – P. 1576–1598. – The electronic version of the printing publication. – URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1475-6773.2006.00566.x/epdf (access date: 22.11.2016).

12. Petrova N., Akulin A. Obosnovanie dizaina nauchnogo issledovaniia i osnovnye metody analiza rezultatov issledovanija [Reasoning for design of research results and principal methods of statistical analysis of research results]. Moscow. – 2014. – 48 p. [RUS]

13. Avdeenko A.M., Kudrja A.V., Sokolovskaja E.A. Nauchno-issledovatel'skaja rabota studentov [Research and scientific activity of students]. Teaching and learning book. Moscow: MISiS. – 2008. – 78 p. [RUS]

14. Vaindorf-Sysoeva M.E. Tekhnologii ispolnenija i oformlenie nauchno-issledovatelskoj raboty [Technology for writing and designing research papers]. Teaching and learning book. Moscow: TsGL. – 2006. – 96 p. [RUS]

15. Sal'nikova T.P. Issledovatelskaja dejatelnost' studentov [Students' research activity]. Teaching and learning book. Moscow: Sfera. – 2005. – 96 p. [RUS]

c) software and Internet resources:

1. Federal portal *Russian Education* URL: http://www.edu.ru/.
2. TSU Research Library URL: http://lib.tsu.ru/ru/node/1290.
3. Information and educational portal *e-Journals* URL: http://www.eduhmao.ru/info-.
4. e-Library of dissertations URL: www.diss.rsl.ru.

14. Equipment and resources

Equipment and resources are provided by the departments organising pre-graduation practice (laboratories of the Department of General and Experimental Physics, laboratories of Maastricht University and Siberian State Medical University).

To process empirical data and prepare Master's Thesis, students can use the Laboratory for Modelling Physical Processes in Biology and Medicine (TSU, building 2, room 422). The laboratory is equipped with an interactive board, sound and video equipment, multimedia equipment to make presentations, and other learning materials. There are PCs with the Internet access. The room has a local network to enable data transfer between students.

TSU Research Library provides Master's Students with an open access to its resources. On 1 January 2016 the fund of Research Library made up 3,835,710 units. Users are provided with online access to a wide range of remote and local databases of research and educational resources: 67 full-text databases including e-library and e-catalogue of Tomsk State University. Full-text databases provide access to 10,000 full-text journals (mostly international) with archives, 170,000 books, 2.9 mln dissertations, reviews, and statistical, analytical and other materials. The databases of Scopus, Web of Science, e-Library, resources of Springer, journals published by Elsevier, Oxford University Press, East View, Polpred, JSTOR are widely used. High-speed Internet is provided.

15. Supervisor of practical training

Master's students' pre-graduation practice is guided by supervisors of their Master's Theses.

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Approved at the meeting of Teaching and Learning Committee of the Faculty of Physics. Minute No 6-16 dated 30.06.2016

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01.09 20/6

ASSESSMENT TOOLS FOR
practical training

PRE-GRADUATION PRACTICE

subject area

03.04.02 Physics

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Physics Methods and Information Technologies in Biomedicine

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Master of Science

Mode of study

Full-time

Tomsk–2016

12. Assessment tools for mid-term assessment of Master's Students' progress in pre-graduation practical training (see Assessment Tools for Practical Training) include:

- List of graduates' competencies developed within pre-graduation practice:

(GC-1) (Level II): ability for abstract thinking, analysis and synthesis;

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

(GC-3) (Level II): ability for self-development, self-realization and use of creative potential;

(GPC-1) (Level II): 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-2) (Level I): ability to guide a team in their professional activity being tolerant of social, ethnic, confessional and cultural differences;

(GPC-3) (Level I): ability for social mobility and organization of research and innovative works;

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

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

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

(PC-1) (Level II): 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-4) (Level I): ability to plan and organize physics studies, scientific seminars and conferences;

(PC-5) (Level II): ability to use skills in designing technical documentation, reports, reviews, papers and articles;

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

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

(SPC-3) (Level I): knowledge of the main methods to determine molecular targets and its applications in biomedical diagnostics;

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

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

- Maps of competencies developed within pre-graduation practice are provided in Annex 1.
- System of assessment:

Structure of assessment

1.	Presentation of mid-term results at seminar of a scientific group (at least 3 scientific seminars)	30%
2.	Report on practice (pre-defence)	70%

- Assessment tools

Assessment tools for the outcomes of the practical training encompass questions on reasoning the choice of a research topic, literature review and conclusions based on the literature, specifics of techniques for data acquisition and processing. Students are asked the questions during the seminars of a scientific group/meeting of the Department or discussion of the results with a supervisor.

Sample questions asked at the defence of pre-graduation practice

1. Description of a research subject.
2. Research problem.
3. Development of working hypothesis.
4. Selection of research methods.
5. Experimental equipment and mathematical software packages used in research.
6. Preparation and conduction of experimental part.
7. Structure of work: summative experiment (testing), formative or transforming experiment (constructing), and control experiment.
8. Work with scientific literature, technical and technological documents.
9. Creation of a physics and mathematical/mathematical model. Reasons for using the model.
10. Methods for processing and interpreting experimental results and comparing them with the results of modelling.
11. Comparison of the facts obtained in the experiment with results of other authors (they can match or contradict).
12. Evaluation of reasons for discrepancy of results (conditions, age, heterogeneous respondents, insufficient duration of the experiment, etc.).
13. Perspective or scientific theory, or concept results can be explained from.
14. Make conclusion on approval/disproval of the working hypothesis.
15. Individual results in percentage.
16. Principal research results.
17. Feasibility of research.
18. Main practical recommendations.

Requirements for the presentation of a Master's Thesis

Pre-defence of a Master's Thesis (report and presentation) is held at the meeting of the Department. Presentation of the Master's Thesis must cover the following issues:

- goals, tasks, content of the Master's Thesis;
- research problems;
- used methods and equipment;
- results of the Master's Thesis;
- feasibility;
- conclusion.

Presentation must contain figures and graphs clearly demonstrating the results of the Master's Thesis.

Upon completion of the examination students are awarded pass or fail based on the results of presentation and supervisor's reference letter (Annex 2).

Annex 2

Reference letter of a supervisor of pre-graduation practice

Reference letter is based on observations of scientific and research activity of a Master's Student along with the results of completed tasks and report on the practical training.

Date

Signature/Name and surname