**PRACTICE (INTERNSHIP) PROGRAM**

**CORE EDUCATION PROGRAMME OF THE HIGHER EDUCATION – MASTER’S PROGRAMME**

«System and Software Engineering»

Area **09.04.04** *Software Engineering*

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|  | Approved  by the Academic Council of Education Programme  Minutes # 02 dated 20.05.2019 |
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| The author | Konstantin Y. Degtyarev |
| Practice (internship) scope in credit units | 6 credits |
| Duration of practice (internship) in academic hours, including the amount of contact work in hours, or the duration of the practice (internship) in weeks | 228 academic hours, including 2 hours of contact work  (2 weeks) |
| Year of Studies | 1st year |
| Type of practice (internship) | Industrial |
| Course of practice (internship) | Scientific and Research |

# GENERAL TERMS

## Goals and Tasks of the Practice (Internship)

The objectives of the scientific and research practice are:

## (а) Planning (including the development of conceptual models, research programs) and organization of research; development of own research project,

## (b) Independent research in the relevant subject area, scientific field, at the junction of branches of science; definition and structuring of the research problem in the field of professional activity, independent choice and justification of the object, subject, goals, tasks and methods of research relating to current issues in the professional field, and their implementation,

## (c) Drafting, editing and reviewing analytical reports, reviews and analytical briefs, scientific/scientific-technical publications, information materials on research results,

## (d) Participation in the organization and work of scientific seminars, scientific and thematic conferences, summer schools, symposia,

## (e) Self-searching, monitoring, assessment (validation) and processing of information sources (including the ones in foreign languages),

## (f) Selection of methodology and tools for analysis in accordance with conditions, goals and specified tasks,

## (g) Analysis of applied research data using qualitative and quantitative methods,

## (h) Analytical support for the development, adoption, implementation and assessment of decisions taken at various activity levels, as well as the development of recommendations for the main subjects of professional activity.

## The Place of Practice (Internship) Within the Framework of the Education Programme (EP)

The Scientific and Research Practice (SRP) relates to the Block 2. “Practice(s), Project and (or) Scientific and Research work” of the Curriculum of the Master's Programme “System and Software Engineering", training area 09.04.04 “Software engineering”.

The research practice (internship) should be a continuation of the students' work on the subject of interdisciplinary coursework (project), carried out during the 1-st year of study. The main requirement for successful completion of the practice (internship) is to rightly master the curriculum of the 1st year of study, and to choos the research topic as a continuation of the coursework (project’s activity) and/or the beginning of the work on the topic of the graduate qualification work.

To master the discipline, students must possess the following knowledge and competences:

**(а)** Ability to learn, to acquire new knowledge and skills, including the ones in a field other than professional,

**(b)** Ability to work with information: find, assess and use information from a variety of sources,

**(c)** Ability to present problems and situations relating to professional activities,

**(d)** Ability to write, arrange, debug and optimize program code in, at least, one programming language,

**(e)** Ability to communicate in writing and orally in both Russian and English (the former is not required from foreign students, however, it is very encouraged).

It is allowed to undergo industrial (scientific and research) practice at the place of work, provided that the goals and tasks of the work activity are consistent with the goals and tasks of the practice. In addition, it is necessary to discuss the issue with a person responsible for the organization (coordination) of the practice at the University.

It should be noted that the knowledge, skills and abilities acquired by the students in the course of their scientific and research practice (internship) are necessary for the successful completion of the project, preparation of the graduate qualification work at the second year of studies, as well as for the subsequent employment of graduates.

The way of conducting production (scientific and research) practice is positioned as stationary one**.**

# THE LIST OF PLANNED LEARNING OUTCOMES IN THE COURSE OF PRACTICE (INTERNSHIP) CORRELATED WITH THE PLANNED RESULTS OF THE EDUCATION PROGRAMME (COMPETENCES)

The practice (internship) process is aimed at developing the following competencies:

**Table 1**

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| --- | --- | --- |
| Code of competence | Competence’ statement | Professional tasks that require this competence |
| ПК-1 *(in Russian)* | Student can select and develop methods of analysis of objects of professional activity on the basis of general tendencies of software engineering development | Tasks related to the definition and structuring of the research (project) problem within the framework of the practical assignment; finding (analysis and selection) of effective approaches to the analysis of the objects of professional activity |
| ПК-2 *(in Russian)* | Student can analyze, synthesize and optimize solutions to ensure the quality of objects of the professional activity | Tasks related to independent selection, analysis and justification of the proposed solution(s), skills to solve poorly (weakly) structured problems, development of recommendations (independent proposals and solutions elicited as a result of collective discussions with stakeholders) to improve the proposed solutions; use of quantitative and qualitative metrics in relation to the objects of professional activity |
| ПК-3 *(in Russian)* | Student can organize independent and collective research work (activity) | Tasks related to the planning of all stages of the work in accordance with the practice assignment (consequently, it may involve the accomplishment of certain works within the framework of a group project, which requires active cooperation with all team members); participation in discussions (seminars) dedicated to specific research topics |
| ПК-4 *(in Russian)* | Student can plan, manage and control the fulfillment of customer's requirements to the software product in the process of its development | Tasks related to the formation of a vision of the solution to the problem under consideration, the scope of work, understanding of existing limitations, ways to clarify ambiguous or contradictory requirements (development and improvement of skills of the company/participation in the dialogue with a customer) |
| ПК-16 *(in Russian)* | Student can carry out software development | Tasks related to improvement of software development skills (stack of technologies and methodologies, programming languages, software deployment, continuous integration, release management, modular testing, version control, etc.) |

# The structure and content of the practice (INTERNSHIP)

The total workload of the industrial practice is 6 credits, 228 hours in total, including, at least, 2 academic hours of contact work; the total duration of the practice is 2 weeks (14 calendar days).

The exact time periods for practical training (practice) are specified in the individual assignment of the student and are confirmed by the Order issued at the Faculty.

The practice (internship) can be conducted either continuously or on a discrete basis, by alternating periods of practice in the student's individual schedule with the study periods for theoretical courses as stipulated in the Curriculum. It is possible to combine discrete and continuous practical work activities based on their types and periods of work. Types and content of student’s practical work are presented in Table 2.

**Тable 2**

|  |  |  |  |
| --- | --- | --- | --- |
| ## | Types of practical work of a student | Content of activities | Codes of competencies to be formed |
|  | Preparation of a research article, a report at the conference(s), a presentation, and/or various training (support) materials | Literature review, research, classification and description of the studied material, results obtained, presentation of material in the required format of a target event | УК-1, УК-2, УК-4, УК-8, ОПК-3, ПК-2, ПК-3 *(in Russian)* |
|  | Preparation of a literature review on the subject of the project – coursework or future graduate qualification work; independent in-depth search, monitoring, evaluation (validation) and processing of sources of information (in Russian and English); well-grounded choice of methodology(-ies) and tools for analysis in accordance with the specified conditions, goals and tasks | Study of sources on the subject under consideration, substantiated selection and assessment of the quality of methods (approaches/technologies) under view, selection of the ‘best’ (under specified set of quality criteria) approach (method/technology) in relation to the task under chosen qualitative and quantitative measures | УК-1, УК-4, ОПК-3, ОПК-6, ОПК-7, ПК-1, ПК-2 *(in Russian)* |
|  | Research and application of modern methods of software engineering (methods and technologies of software development), data analysis, algorithms, etc.; justification, validation and optimization of design solutions to ensure compliance with customer requirements and compliance with the set of specified quality parameters | Carrying out of experimental calculations based on existing methods of data analysis, comparison of results of experiments conducted by means of different methods. Justification of the selected design solutions, and/or used technology stack | УК-1, УК-4, ОПК-3, ОПК-6, ПК-3, ПК-4, ПК-16 *(in Russian)* |
|  | Work with the software required to carry out research tasks in the field of the project’s topic – coursework or future graduate qualification work; decision-making under management competence; planning and implementation of the software development process | Analysis of existing, application and testing of selected software solutions with reference to the task(s) in hand; planning of the software development (research) process | ОПК-3, ПК-4, ПК-16 *(in Russian)* |

# PRACTICE (INTERNSHIP) REPORTS

The form of reporting on the results of the internship (the document submitted by the student is in both hardcopy and softcopy forms) – report covering the scope and content of the work done by the student during the internship (performing of individual assignment), skills acquired, and the competences formed (see Appendix 1 for a title page format supplied with an appr. content the of report). Submitting and storing the reports is carried out mainly with the use of a special module of the electronic Learning Management System of the National Research University Higher School of Economics (**LMS** | <https://lms.hse.ru/> ). All documentation provided by a student is written in English (we implement a *gradual* transition to mandatory compliance with this requirement).

# INTERIM PRACTICE (INTERNSHIP) ASSESSMENT

## Criteria and Grading Scale for Interim Practice (Internship) Assessment

There is no provision for the current control over educational practice (internship) – in fact, such control is carried out continuously at the stages of implementation of the project (work) by a student at the place of practical training (internship).

The exam is carried out in the form of a review by the person responsible for the practice’ (internship) organization (on the university site) of **(a)** practice (internship) report, and **(b)** provided supervisor's opinion (filled in review form) concerning the compliance of the results attained with the practice program (assignment), as well as the compliance of the supervisor’s recommended grade with the established criteria of intermediate attestation (assessment) of the practice (internship). The review’s (see item **(b)** above) text is prepared in a free form, including a brief description of the tasks performed by a student, assessment of the completeness and quality of the practice plan’s implementation, student's attitude to the realization of assigned work, conclusions about student’s background (knowledge level) and professional eligibility of a student; if needed, the supervisor’s report may contain additional comments and notes.

If necessary (e.g. emerging questions), the person responsible for the practice’ (internship) organization (coordination) on the university site may interview a student. The Manager of the Education Programme is responsible for coordinating the schedule of such interview(s), and the interview(s) may be conducted face-to-face or remotely. The grade for the exam considers the completeness and quality of the **work** (individual assignment) done by student, as well as the completeness and quality of the submitted practice’ (internship) **report**. The results of the examination are fixed in a Grading sheet, which is handed over to the Office of Studies.

Results of the practice (internship) are formed on the basis of the following indicative scale:

**(a)** The grade of "8-9-10" (*"excellent"* – *"brilliant"*) will be awarded to student, if he/she has completed the practice (internship) assignment in full and correctly, in an excellent manner (e.g., a student has created a full-fledged software product/module ready for use, prepared a research draft that can be used as a basis for future publication, or materials for summer schools, workshops, training seminars with active participation in the latter, etc.), did not receive any comments (in review form) from the supervisor (at the place of practice), and in due time submitted to the Office of Studies or to the person responsible for the practice’ (internship) organization a report drawn up in accordance with all requirements of the practice,

**(б)** The grade of "6-7" (*"good"* – *"very good"*) will be awarded to a student, if he or she submits a report on the completed internship to the Office of Studies or to the person responsible for the practice’ (internship) organization in a timely manner, but receives minor comments regarding the completeness and quality of the internship assignment(s), the design, completeness and correctness of the presentation of the material(s) in the report submitted,

**(c)** The grade of "4-5" (*"satisfactory"* – *"pretty satisfactory"*) will be awarded to a student, if he or she submittes a report on his or her internship to the Office of Studies or to the person responsible for the practice’ (internship) organization in a timely manner, but has received significant comments (criticism) regarding the completeness and quality of the handling task(s), the design and completeness of the presentation of the material(s) in the report submitted,

**(d)** The grade "0-1-2-3" (*"very bad"* – *"unsatisfactory"*) will be awarded to a student who fails to complete the practice (internship) program, i.e. either he/she completed only a small part of a set of internship task(s), did not demonstrate required skills and abilities while performing assigned task(s), or did not submit an internship (practice) report within the established time period (before or at specified deadline).

Students who do not complete their practice (internship) programs within the time period specified in the Curriculum are reassigned to the practice (internship) during their spare time. In such a case, the supervisor (at the place of practice) and the practice assignment (tasks) are not subjects to change.

## Evaluation Resources for Interim Practice Assessment (Attestation)

The evaluation resource fund (set) includes individual assignments in accordance with the objectives of the practice (internship), students' reports on the internship, review from the supervisor of the internship.

Students who have completed the internship program and submitted both reports and reviews on the practice (internship) within the predefined time period will be attested based on the results of their internship.

Selected examples of the control (test) questions and tasks on specific stages of the practice (internship), which are mastered by students individually in the course of practical training and report preparation, can be as follows:

1. Acquisition and analysis of requirements, functional and non-functional requirements,
2. Profiles of software life cycle standards,
3. Software project management models and processes,
4. Methods of planning and management of software life cycle resources,
5. Software design, API design and usage, error handling, exception handling, fault tolerance,
6. Software testing,
7. Stages and principles of quality management of development processes over the life cycle of software development,
8. Software development technologies, justified choice according to requirements of the task,
9. Principles of methodological justification of scientific research,
10. Modern methods of scientific research to form opinions (judgments) and conclusions on the relevant problems associated with professional activities,
11. Basic principles of planning, organizing and conducting research in the field of professional activity,
12. Standard software solutions focused on scientific, design and technological tasks,
13. Principles of choosing technical and economic models of evolution and software support,
14. Methods of logical and methodological analysis of scientific research and its results,
15. Methods of scientific search in the development of new ways of solving professional and socio-economic problems in the field of activity,
16. Principles of software product version and release management, configuration integrity support skills during the life cycle of a software project,
17. Working in a team, team collaboration, overcoming the complexity of the problem(s) associated with ambiguity, uncertainty and risk; interacting with stakeholders,
18. Methods of quality assurance of the objects of professional activity,
19. Design and management technologies relating to professional objects.

# EDUCATIONAL, METHODOLOGICAL AND INFORMATION SUPPORT of the practice (internship)

**The list of educational materials and resources on the Internet that are required (recommended) for the practice (internship)**

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| ## | The title(s) |
| Basic (recommended) materials (printed  publications) and Internet resources | |
| **1** | The Guide to the Software Engineering Body of Knowledge (SWEBOK Guide), ver.3.0, IEEE Computer Society, 2018, <https://www.computer.org/education/bodies-of-knowledge/software-engineering> (type of access: free) *(in English)* |
| **2** | Guide to the Systems Engineering Body of Knowledge (SEBoK Guide), INCOSE, IEEE Computer Society, Stevens Institute of Technology, ver.2.1, 2019, <https://sebokwiki.org/wiki/Guide_to_the_Systems_Engineering_Body_of_Knowledge_(SEBoK)> (type of access: free) *(in English)* |
| **3** | IEEE Computer Sociey website (expert opinions, publications / ComputingEdge, Tech News, etc.), <https://www.computer.org/> (type of access: free) *(in English)* |
| **4** | Орлов С.А. Программная инженерия: технологии разработки программного обеспечения, изд-во ‘Питер’, 2016 (ISBN: 978-5-496-01917-0) / type of access: HSE Library *(Russian edition of the book)* |
| **5** | Journal of Software Engineering Research and Development, vol. 1/2013 – 6/2018, Springer Berlin Heidelberg, <https://link.springer.com/journal/40411> (type of access: electronic resources of HSE Library) *(in English)* |
| **6** | Вольфсон Б. Гибкое управление проектами и продуктами, изд-во ‘Питер’, 2017 (ISBN: 978-549-60132-39) / type of access: HSE Library *(Russian edition of the book)* |
| **7** | Коул Р. Блистательный Agile: гибкое управление проектами с помощью Agile, Scrum и Kanban, изд-во ‘Питер’, 2019 (ISBN: 978-5-446-11051-3) / type of access: HSE Library *(Russian edition of the book)* |
| **8** | Ньютон Р. Управление проектами от А до Я, изд-во ‘Альпина Паблишер’, 2018 (ISBN: 978-5-961-46940-0) / type of access: HSE Library *(Russian edition of the book)* |
| **9** | Гецци К. Основы инженерии программного обеспечения, изд-во ‘БХВ-Петербург’, 2005 (ISBN: 978-5-941-57403-7) / type of access: HSE Library *(Russian edition of the book)* |
| **10** | Software and Systems Modeling, vol. 1/2002 – 18/2019, Springer Berlin Heidelberg, <https://link.springer.com/journal/10270> (type of access: electronic resources of HSE Library) *(in English)* |

# educational, methodological and information support of the practice (internship)

While undergoing practical training (internship) at the National Research University Higher School of Economics students can actively use computer classrooms, computer network, library, personal computers, research and other equipment of the University, which are necessary for the successful completion of the practical assignments.

When undergoing practice (internship) in a professional organization (company) in accordance with the internship agreement, students can use laboratories, specially equipped rooms (offices), search engines, databases, library, technical and other documentation, computer equipment in the organization where they are practicing, necessary for the successful completion of the internship assignment (in line with company’s internal rules and regulations). All these questions can be coordinated on the spot with the supervisor of practice (company’s site).

The list of information technologies used in practice, including a list of software and information reference systems: in the process of practical training (internship), students can use information (software and hardware) resources, including operating systems, computer systems for development/modeling/simulation, means of automation of design and development of software, various stacks of technologies, etc., used in the professional organization (company), on the basis of which the practice (internship) activity is carried out with the aim of successful completion of all assigned tasks.

While undergoing practical training (internship) at the National Research University Higher School of Economics, students can use a variety of software products, including Windows 7/8/10, Microsoft Office 365 (Word, Excel, PowerPoint, Sway, OneNote, etc.), as well as licensed Microsoft software for developers (Azure Dev Tools for Teaching, <https://azure.microsoft.com/en-us/education/institutions/dev-tools-for-teaching-faq/> ) under the framework of the Microsoft Imagine Program.

**Appendix А: < *Sample cover page of the internship report* >**

Federal State Autonomous Educational Institution

For Higher Professional Education

National Research University Higher School of Economics

Faculty of Computer Science

Education Programme **«System and Software Engineering»**

Master’s Degree Programme

Area **09.04.04** *Software Engineering*

**R E P O R T**

**on Industrial (Scientific and Research) Practice / Internship**

Completed by the Student

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(Surname, Name) (Group)

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(signature)

**Checked Out:**

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(position, Surname, Name – supervisor at the company’s site)

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(grade) (signature)

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Stamping place (date)

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(position, Surname, Name – responsible person / University)

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(grade) (signature)

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(date)

**Appendix А *(cont-d)*: The approximate structure of the report:**

1. Introduction (the goals and main tasks of the practice (inernship) must be clearly described in this section),
2. Content section,
3. An individual assignment done during the period of practice (internship) with a description of details of the work done (in line with imposed NDA requirements),
4. Conclusion (including self-assessment of competence formation),
5. Annexes (charts, schemes, tables, algorithms, illustrations, etc.), if any.

**The text of the report** should include the following sections:

1. Brief profile of the organization (place of practice/internship) with a description of the area of activity, organizational structure, economic indicators,
2. Description of the professional tasks, which are assigned to student for the period of practice/intership (in accordance with the goals and objectives of the internship program and individual task(s)).

**Appendix B: < *Sample review of a student's work* >**

**REVIEW**

**of the student’s work from the practice (internship) site**

The filled in review form is prepared upon completion of the student’s practice (internship) by the supervisor from the enterprise (company). The review should include the student's name, initials, place of internship, and period (‘from-to’) of internship.

The review must contain the information concerning:

1. professional tasks solved by the student,
2. completeness and quality of the practice program’s implementation,
3. characteristics of student's attitude to the accomplishment of the tasks assigned to him/her for the period of the practice (internship),
4. assessment of the development of expected competencies (descriptors of their formation).

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| --- | --- | --- |
| Competence Code | Competence statement / descriptors | Assessment of formation strength (in point, verbal) |
|  |  |  |
|  |  |  |
|  |  |  |

1. conclusions concerning the student's professional aptitude; if necessary, comments on his/her personal and professional qualities (as a young specialist).

The filled in review form is signed by the supervisor of practice (internship) from the enterprise (company) and stamped.