

*Federal State Autonomous Educational establishment of higher education  
RUDN-University*

*Engineering Academy*

Recommended by ICSS

## **FINAL STATE EXAMINATIONS PROGRAM**

**Recommended for the program track:** 09.06.01 Informatics and computer engineering

**Educational program specialization:** Management in social and economic systems (engineering science):  
strategic management

**Qualification (degree) of the graduate:** Researcher, teacher-researcher

## 1. General Provisions

1.1. Responsibility and procedure for the preparation and conduct of state final tests at RUDN University, as well as the list, sequence, timeline for passing the documents necessary for the implementation of state final attestation, between structural divisions determines the Procedure for conducting the final state attestation of students.

1.2. Final State Examinations (FSE) 09.06.01 Informatics and computer engineering, includes two types of certification tests:

- state exam (SE);
- defense of scientific qualification thesis (SQT).

2. The results of each type of certification tests included in the FSE are determined by the grades "excellent", "good", "satisfactory", "unsatisfactory".

## 3. The purpose and objectives of Final State Examinations Program

3.1. **Aim** of FSE is to determine the compliance of the results of mastering the educational program with the requirements of the educational standard of the RUDN University in the direction of education 06.09.01 Informatics and computer technology, approved by the Rector's Order No. 96 of 02/26/2015.

### 3.2. Objectives of FSE:

- completion of the formation and determination of the student's level of competence formation, provided for by the educational standard of the RUDN University in the direction of training 09.06.01 Informatics and computer technology;
- determination of the level of theoretical and practical preparedness of the graduate to solve scientific and professional problems, in the areas of professional activity defined by the educational standard of RUDN University;
- making a decision by the State Examination Commission (SEC) on assigning the qualification "Researcher" to a student who has fully mastered the educational program. "Teacher-researcher".

## 4. The program of the Final State Examination

4.1. Within the framework of the SE, the degree of mastering the following competencies by graduates is checked:

### Universal competencies:

- able to analyze critically and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including in interdisciplinary areas (UK-1);
- able to design and carry out complex research, including interdisciplinary, based on a holistic systemic scientific worldview using knowledge in the field of history and philosophy of science (UK-2);
- ready to participate in the work of Russian and international research teams to solve scientific and scientific and educational problems (UK-3);
- ready to use modern methods and technologies of scientific communication in the state and foreign languages, including the readiness to communicate in oral and written forms in Russian and foreign languages to solve problems of professional activity, possession of foreign language communicative competence in official business, educational professional, scientific, socio-cultural, everyday life spheres of foreign language communication (UK-4);
- able to follow ethical standards in professional activity (UK-5);
- able to plan and solve problems of one's own professional and personal development (UK-6)

### General professional competencies:

- know the methodology of theoretical and experimental research in the field of professional activity (GPC-1);
- possess of the culture of scientific research, including the use of modern information and communication technologies (GPC-2);
- able to develop new research methods and their application in independent research activities in the field of professional activity (GPC-3);
- ready to organize the work of the research team in the field of professional activity (GPC-4);
- able to evaluate objectively the results of research and development carried out by other specialists and in other scientific institutions (GPC-5);

- the ability to present the results of research activities at a high level and taking into account the observance of copyright (GPC -6);
- get knowledge of methods of conducting patent research, licensing and copyright protection when creating innovative products in the field of professional activity (GPC-7);
- ready to teaching activities in basic educational programs of higher education (GPC -8)

Professional competencies:

- know the methodology of theoretical and experimental research in the field of informatics and computer technology, possession of the culture of scientific research in the field of informatics and computer technology, including the use of the latest information and communication technologies (PC-1);
- able to develop new research methods and their application in independent research activities in the field of informatics and computer technology, taking into account the rules of observance of copyright (PC-2);
- ready for independent (including leading) research activities, requiring broad fundamental training in modern areas of branch science, deep specialized training in the chosen direction, possession of the skills of modern research methods (PC-3);
- get fundamental knowledge in the main sections of computer science and computer technology, including the theoretical foundations of computer science, mathematical modeling, numerical methods and software packages, system analysis, information management and processing, elements and devices of computer technology and control systems, management in social and economic systems, use information retrieval systems, use experimental research techniques (PC-4).
- get fundamental knowledge in the main sections of informatics and computer technology, must have the ability to conduct scientific research and obtain new scientific and applied results (PC-5).

4.2. The volume of the SE: the total number of examination tickets is determined by the number of graduate students admitted to the SE. Each exam ticket contains three questions.

4.3. Contents of the State Examination (an indicative list of questions to be submitted for the state examination):

The subject of management theory. Management relations and the concept of organizational management. Management objectives. Goal tree. Specifics of working with target information. Efficiency criteria and limitations in achieving the goal. Management in complex systems. The concept of feedback and its role in management. Formalization and formulation of management tasks. Basic structures and methods of management of socio-economic systems: administrative and organizational, economic, socio-psychological, etc. Specificity of management of social and economic systems. Mathematical and simulation modeling. The role of man in the management of social and economic systems. A systematic approach to solving social and economic management problems. Basic concepts of the systems approach, properties of the system. Organization as a system. The basic concepts of the sociology of organizations and social psychology: power, leadership, communication, authority, leadership styles. The concept of management functions and their classification, general and specific functions, strategic planning in organizational management systems, tactical and operational planning. Operational management, organization and communication. Models and methods of decision-making, decision-making under conditions of risk and uncertainty, the use of expert assessments in decision-making. Consulting activity in decision-making, psychological aspects of decision-making and implementation, peculiarities of collective decision-making, peculiarities of decision-making in emergency situations, negotiations and elections, personality and collective as objects of management. Society as a socio-economic system. Social structure of society, social institutions, their functions and interaction. Communication of social and economic aspects of management. Principles and criteria for the formation of management structures in socio-economic systems. Management theory. Management relations and the concept of organizational management. Information technologies in control systems of socio-economic systems. The concept of the state of the external environment and the control object in organizational feedback control systems. Features of the creation and use of information support for organizational management systems, Information support in emergency situations. Management efficiency concept. Methods for assessing activities and management efficiency. Problems of analysis and synthesis of mechanisms of functioning and management of socio-economic systems. Methods for obtaining and processing information for management tasks, expert procedures and forecasting procedures. Preparation and adoption of management decisions. Automated management decision support systems. Computing technology and software in the management of socio-economic systems. Modeling method and its use in research and design of control systems. Model concept, model classification. Boundaries and possibilities of

formalizing procedures for managing social and economic systems. System models: static, dynamic, conceptual, topological, formalized (procedures for formalizing system models), informational, logical-linguistic, semantic, set-theoretic, etc. Economic and mathematical methods and models. Production functions. Models of Leontiev, Arrow-Debre, Neumann-Gale and others. Principles, models, methods and tools for the design and development of organizational systems. Management in complex systems, feedback and its role in management, entropy and information as characteristics of diversity and management, the principle of required diversity. Information support of organizational systems, information languages and classifiers, software of organizational systems, its features, reservation of software modules and information arrays, information protection. Mathematical foundations, models and methods of managing socio-economic systems. Research methods of operations and their area of application for solving problems of managing socio-economic systems. Description of the main tasks of researching operations related to the theory of queuing, the theory of queues and inventory management. Statement of mathematical programming problems. Optimization approach to the problems of managing socio-economic systems. Admissible set and objective function. Forms of recording mathematical programming problems. Classification of mathematical programming problems. Linear programming problems. Statement and geometric interpretation of linear programming problems. Linear programming methods. Direct and dual problems of mathematical programming. Simplex method. Multiobjective linear programming problems. Models and numerical methods for unconstrained optimization. Classification of methods of unconstrained optimization. Convergence rates. First order methods. Gradient methods. Newton's method and its modifications. Quasi-Newtonian Methods. Finite difference methods. Zero-order methods: coordinate descent methods, Hook-Jeeves, conjugate directions, deformable configuration methods, simplex methods. Non-linear problems of mathematical programming. Local and global extremum, optimality conditions, Kuhn-Tucker conditions. Conditional extremum problems and the Lagrange multiplier method. Design methods. Gradient projection method. Conditional gradient method. Methods for reducing problems with constraints to problems of unconstrained optimization. Methods of external and internal penalty functions. Combined design method and penalty functions. The method of mirror constructions. Sliding tolerance method. Stochastic programming problems. Stochastic quasi-gradient methods. Stochastic approximation methods. Methods with averaging operation. Random search methods. Stochastic problems with constraints on the probabilities of nature. Stochastic difference methods. Methods and problems of discrete programming. Integer linear programming problems. Gomori pruning techniques. Branch and bound method. The assignment problem. Hungarian algorithm. Fundamentals of graph theory: definition of a graph, chains, cycles, paths, contours. Connected and strongly connected graphs. Graph adjacency matrix. The incidence matrix of arcs and edges of graphs. Trees. Plane graphs. Shortest paths and contours. Algo-rhythms of Ford and Danzig. Circulation of the maximum value and the potentials of the permutations. Maximum flow. Ford-Fulkerson algorithm. Resource allocation problems on networks and graphs. Dynamic programming method for multistep decision-making solutions. Bellman's optimality principle. Basic functional equation. Computational scheme of the dynamic programming method. Subject and basic concepts of game theory. Application of game theory to optimize management decisions. The concept of strategy and solution of the game. Equivalence: in dominant strategies, maximin, Nash, Bayes, Stackelberg. Matrix games. Games with consistent interests. Cooperative games. Statement of decision making tasks. Stages of problem solving. Expert procedures. Methods for obtaining expert information. Measurement scales, expert measurement methods. Methods of polling experts, characteristics of experts. Methods for processing expert information, assessing the consistency of expert opinions. Methods for multi-criteria assessment of alternatives. Classification of methods. Lots of compromises and agreements, building of sets. Utility function. Axiomatic methods of multicriteria assessment. Direct methods for multi-criteria assessment of alternatives. Methods for normalizing criteria. Characteristics of the priority of the criteria. The postulated principles of optimality (uniformity, fair assignment, main criterion, lexicographic). Utility function approximation methods. Decision trees. Payment methods. Analytical hierarchy methods. Incomparability threshold methods. Dialogue decision making methods. Qualitative decision-making methods (verbal analysis). Making decisions in the face of uncertainty. Types of uncertainty. Statistical decision making models. Bayes-Laplace, Germeier, Bernoulli-Laplace, maximin (Wald), minimax risk of Savage, Hurwitz, Hodges-Lehmann, etc. Making collective decisions. Arrow's theorem and its analysis. Majority rules, Condorcet, Borda. The Condorcet paradox. Distance in the space of relationships. Modern concepts of group choice. Models and methods for making decisions with fuzzy information. Fuzzy sets. Basic definitions and operations on fuzzy sets. Fuzzy modeling. Mathematical programming problems with fuzzy initial conditions. Fuzzy relations, operations on relations, properties of

relations. Making decisions with a fuzzy relationship of preferences on a set of alternatives. Decision making with multiple preference relationships. Socio-economic forecasting. Tasks, role and types of forecasting, classification of forecasts by forecasting purpose, type of forecasting objects, forecasting horizon, forecasting scale. Assessment of the reliability of forecasting. Time series and their analysis. Characteristics of the dynamics of socio-economic phenomena. Time series models, analysis of the component composition of series, trends, criteria and methods for identifying trends. Algorithms for identifying trends. Growth Curve Models in Socio-Economic Forecasting. The main types of growth curves, methods of their selection and identification of parameters. Assessment of the quality of predictive models. Criteria for the quality of forecasts. Methods and models for identifying and analyzing periodic fluctuations in time series. Statistical methods, filtering and analysis of spectra. Adaptive models and forecasting methods. Features of adaptive models, their types, construction methods. Stationary and non-stationary time series models, their types and construction methods. Foundations of the theory of active systems. The concepts of an active system and a mechanism of functioning. Scheduling mechanisms in active systems. Non-manipulability of planning procedures. The principle of open control and the optimality of correct control mechanisms. Incentive mechanisms in deterministic active systems and active systems with uncertainty. Consistency of the optimal solution. Basic mechanisms of resource allocation, active expertise, competitive, multichannel, cost-effective. Problems and methods of identification of organizational systems based on retrospective, current and expert information, taking into account the activity of controlled subjects. Methods for modeling the mechanisms of functioning of active systems. Imitation games are a tool for studying organizational mechanisms and a method of active learning. Project management. Specificity of project-oriented organizations. Goals, objectives and stages of project management. Methods of network planning and management. Project management mechanisms. Strategic planning. Reform and restructuring of enterprises. Models and mechanisms of in-house management. Human resource management in organizational systems. Goals and objectives of management, planning of labor resources, selection, training and placement of personnel, assessment of the business qualities of management personnel, use of labor resources, management styles, conflict situations, requirements for management personnel in emergency situations. Tasks and methods of financial analysis. Accumulation and discounting. Effective rate. Payment streams. Financial equivalence of obligations. Typical applications. Credit settlements. Assessment of investment processes. Selection of investment projects. Financial settlements in the securities market. Mathematical foundations of financial analysis under conditions of risk and uncertainty. Risks and their measures. Utility function.

## **5. Study-methodical and information sources for the preparation and passing of the final state exam**

### *5.1. Electronic library system(ELS) РУДН and third-party ELS:*

- ELS RUDN <http://lib.rudn.ru/MegaPro/Web>
- ELS «University Library Online» <http://www.biblioclub.ru>
- ELS Юрайт <http://www.biblio-online.ru>
- ELS «Student's Consultant» [www.studentlibrary.ru](http://www.studentlibrary.ru)
- ELS «Лань» <http://e.lanbook.com/>

Websites of ministries, departments, services, production enterprises and companies whose activities are specialized for the course:

- <http://economy.gov.ru/minec/main/> - website of the Ministry of Economic Development of the Russian Federation

Databases and search engines:

- electronic fund of legal and normative-technical documentation <http://docs.cntd.ru/>
- Yandex search engine <https://www.yandex.ru/>
- search engine Google <https://www.google.ru/>
- abstract database SCOPUS <http://www.elsevierscience.ru/products/scopus/>
- реферативная база данных SCOPUS <http://www.elsevierscience.ru/products/scopus/>

### *5.2. Methodological materials for independent work of students in the process of preparing a scientific report:*

- 1) Матюшок В.М. Основы эконометрического моделирования с использованием Eviews: Учебное пособие / В. М. Матюшок, С.А.Балашова, И.В.Лазанюк. - 3-е изд., перераб. и доп. - М.: Изд-во РУДН, 2015. – 228 с.
- 2) Мокий, М.С. Методология научных исследований: учебник для магистратуры / М.С. Мокий, А.Л. Никифоров, В.С. Мокий; под ред. М.С. Мокия. - М.: Издательство Юрайт, 2018. - 255 с. -

(Серия: Магистр). - ISBN 978-5-9916-1036-0.

- 3) Кафидов В.В., Сопилко Н.Ю. Современный менеджмент: учебник. М.: изд-во РУДН. – 2018. – 320 с.
- 4) Лапаева, М.Г. Методология научных исследований: учебное пособие для аспирантов / М.Г. Лапаева, С.П. Лапаев; Министерство образования и науки Российской Федерации, Федеральное государственное бюджетное образовательное учреждение высшего образования «Оренбургский государственный университет». – Оренбург: ОГУ, 2017. – 249 с.: ил. - Библиогр. в кн. - ISBN 978-5-7410-1791-3; То же [Электронный ресурс]. – URL: <http://biblioclub.ru/index.php?page=book&id=485476> (06.05.2018).
- 5) Теория систем и системный анализ: учебник / В.М. Вдовин, Л.Е. Суркова, В.А. Валентинов. - 3-е изд. - Москва: Издательско-торговая корпорация «Дашков и К°», 2016. - 644 с.
- 6) Зариковская, Н.В. Математическое моделирование систем: учебное пособие / Н.В. Зариковская; Министерство образования и науки Российской Федерации, Томский Государственный Университет Систем Управления и Радиоэлектроники (ТУСУР). - Томск: Томский государственный университет систем управления и радиоэлектроники, 2014. - 168 с.: схем., ил. - Библиогр. в кн.; То же [Электронный ресурс]. - URL: <http://biblioclub.ru/index.php?page=book&id=480523> (19.01.2018).
- 7) Балашова С. А. Эконометрика в задачах и решениях: Учебное пособие для магистров / С.А. Балашова, И.В.Лазанюк. - М.: Изд-во РУДН, 2014. - 188 с.
- 8) Уткин В.Б. Эконометрика. – М.: ИК «Дашков и Ко». – 2013. – 564 с.
- 9) Алексеенко В.Б., Сопилко Н.Ю. Основы логистики: Учеб. пособие. – М.: РУДН, 2011.
- 10) Григорьев М.Н. Логистика: продвинутый курс: учеб. для вузов. – М.: ЮРАЙТ, 2011.
- 11) Логистика: Учеб. пособ./ под ред. Б.А. Аникина. – М.: ИНФРА-М, 2013.
- 12) Алексеенко В.Б., Сопилко Н.Ю. Промышленный маркетинг. – М.: РУДН, 2013. – 178 с.
- 13) Котлер Ф. Маркетинг менеджмент. – СПб.: Питер. – 2015. – 800 с.
- 14) Синяева И.М. Маркетинг в предпринимательской деятельности. – М.: ИК «Дашков и Ко». – 2013. – 268 с.
- 15) Липсиц И.В. Ценообразование. – М.: Юрайт. – 2013. – 401 с.
- 16) Осеев А.А. Маркетинг в отраслях и сферах деятельности. – М.: РУДН, 2015. – 36 с.
- 17) Дегтерев Д.А. Теоретико-игровой подход в маркетинге: уч. пособие. – М.: РУДН, 2014. – 270 с.
- 18) Нуреев Р.М. Курс микроэкономики. Учебник для вузов. - М.: НОРМА-ИНФРА, 2013.
- 19) Микроэкономика [Текст]: Практикум / Под ред. Р.М. Нуреева. - М.: НОРМА: ИНФРА-М, 2016. - 352 с. - ISBN 978-5-91768-689-9.
- 20) Чепурин М.Н. Курс экономической теории: Учебник / М. Н. Чепурин, С. Н. Ивашковский; Под общ. ред. М.Н.Чепурина, Е.А.Киселевой. - 6,7-е изд., доп. и перераб. - Киров: АСА, 2009, 2011, 2015. - 848 с.: ил. - ISBN 978-5-85271-287-5: 520.00.16.
- 21) Агапова Т.А., Серегина С.Ф. Макроэкономика. М., ДиС. 2012.
- 22) Матвеева Т.Ю. Введение в макроэкономику. М., ГУ-ВШЭ. 2015.
- 23) Матвеева Т.Ю., Никулина И.Н. Основы экономической теории. М., Дрофа. 2015.
- 24) Степанова О. М. Макроэкономика [Текст/электронный ресурс]: Курс лекций / О. М. Степанова. - 3-е изд., испр.; Электронные текстовые данные. - М.: Изд-во РУДН, 2015. - 174 с. - ISBN 978-5-209-06381-0.

### 5.3. Additional recommendations

Specialized software for preparing a scientific report and independent work of students:

- Windows 7 (Microsoft Subscription) Enrollment for Education Solutions № 86626883 от 01.04.2018);
- Microsoft Office 2007 (Microsoft Subscription) Enrollment for Education Solutions № 86626883 от 01.04.2018);
- Windows XP (Microsoft Subscription) Enrollment for Education Solutions № 86626883 от 01.04.2018);
- Microsoft Office 2003 (Microsoft Subscription) Enrollment for Education Solutions № 86626883 от 01.04.2018);
- Borland Developer Studio 2006 (License Certificate Number: 33080, 33081, 33082) - MATLAB R2008b (361405 2008 г.);
- Notepad++ (free application) - Acrobat Reader DC (free application);

## 6. Fund of assessment tools to prove the compliance/non-compliance of the level of educational result of graduates who have completed the mastering of the Educational Program of High Education to the requirements of the proper Educational Standard in the RUDN

The appraisal funds are presented in the form of a assessment tools for the SE, namely:

- a list of competencies that students must master as a result of mastering the educational program;
- description of indicators and criteria for assessing competencies, as well as assessment scales;
- typical tasks or other materials necessary to assess the results of mastering the educational program;
- methodological materials that determine the procedures for assessing the results of mastering the educational program.

For example: the rating scale for an oral answer on an interdisciplinary exam:

**A score of «5» (excellent)** is given if:

- the content of the examination paper topic is fully disclosed;
- the topic is presented correctly, in a certain logical sequence;
- demonstrated systematic and deep knowledge of program theoretical material;
- terminology is used accurately;
- the ability to illustrate theoretical positions with concrete examples, to apply them in a new situation is shown;
- the assimilation of previously studied related issues, the formation and stability of competencies, skills and abilities are demonstrated;
- the answer sounded independently, without additional (helping) questions;
- demonstrated the ability to creatively apply the knowledge of theory to solving professional tasks;
- demonstrated knowledge of modern educational and scientific research papers;
- one or two inaccuracies were made when covering minor issues, which are corrected according to the remark.

**A score of "4" (good)** is given if:

- the topics of the examination paper are presented in a systematic and consistent manner;
- the ability to analyze the material has been demonstrated, but not all conclusions are reasoned and evidence-based;
- the mastering of the theory fundamentals is demonstrated.
- the answer mainly meets the requirements for a rating of "5", but at the same time has one of the disadvantages:
- there are small gaps in the presentation that did not distort the content of the answer;
- one or two mistakes were made when covering the main content of the answer, corrected according to the examiner's remark;
- an error or more than two shortcomings were made when covering secondary questions, which are easily corrected by the examiner's remark.

**A score of «3» (satisfactory)** is given if:

- the content of the material is incompletely or inconsistently disclosed, but a general understanding of the issue is shown and skills are demonstrated that are sufficient for further assimilation of the material;
- mastered the main categories on the considered and additional issues;
- there were difficulties or mistakes in the definition of concepts, the use of terminology, corrected after several additional questions;
- with incomplete knowledge of the theoretical material, insufficient formation of competencies, abilities and skills was revealed, the student cannot apply the theory in a new situation;
- the knowledge of basic literature is demonstrated.

**A score of «2» (unsatisfactory)** is given if:

- the main content of the educational material has not been disclosed;
- found ignorance or misunderstanding of the most important part of the educational material;
- mistakes were made in the definition of concepts, when using terminology, which were not corrected after several additional questions.
- competencies, skills and abilities are not formed и.

## 7. Scientific Qualification Thesis (SQT)

7.1. A student who has passed the State Examination is allowed to defend the SQT. The defense of the SQT is held at an open meeting of the State Examination Commission (SEC). in the form of an oral presentation of the SQT with subsequent oral answers to the questions of the SEC members. The report and / or answers to the questions of the SEC members can be made in a foreign language. During the defense of the SCT, the degree of mastering by graduates of the competencies specified in clause 3.1 of this program is checked.

7.2. List of approximate examples of SQT topics:

- 1) Development of a model for managing investment activities at enterprises of the oil-extracting industry.
- 2) Development of a mechanism for assessing the effectiveness of socio-economic systems in construction.
- 3) Development of a management mechanism in the socio-economic systems of the automotive industry.
- 4) Development of a mechanism for strategic knowledge management in the corporate education system.
- 5) Development of a mechanism for managing economic systems in mechanical engineering.
- 6) Management of the formation of a system of social partnership in the field of legal services.
- 7) Controlling as a mechanism for effective management of an industrial enterprise.
- 8) Development of an economic and organizational model of energy-saving technologies.
- 9) The system of financial and economic monitoring as a factor in the socio-economic management of the organization.
- 10) Development of a decision support system for strategic planning of the enterprise.
- 11) The balanced scorecard as a factor in increasing the effective performance of the organization.
- 12) Model of management and structure of the enterprise on the example of small-scale production.
- 13) Assessment of the prospects for the development of network technologies in Russia.
- 14) Development of innovative approaches to providing the economy of Nigeria with national engineering personnel.
- 15) Development of innovative technologies for creating small and medium-sized businesses in the Republic of Bangladesh.
- 16) Research and development of business management models for state-owned companies in Venezuela.
- 17) Development of methodology and methods for assessing innovation in small business in China
- 18) Development of an innovative project of design management methods for the development of the economy of Nepal.
- 19) The role of the national mining industry in the modern economic development of the countries of South Africa.

7.3. The stages of the SQT implementation, the conditions for the student's admission to the SQT defense, the requirements for the structure, volume, content and execution of the explanatory note to the SQT, as well as the list of mandatory and recommended documents submitted for the SQT defense are indicated in the methodological instructions approved in the established order and placed in the TUIS RUDN.

The program was drawn up in accordance with the requirements of the OS of the RUDN.

Associate professor

E.A. Kovaleva

**Head of the educational program,  
Director of the Department**

O.E. Samusenko