

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION  
 Federal State Autonomous Educational Institution  
 Higher Education  
 "Ural Federal University named after the First President of Russia B. N. Yeltsin"

Graduate School of Economics and Management

APPROVED BY  
 Vice rector for science  
 A. V. Germanenko  
 2023

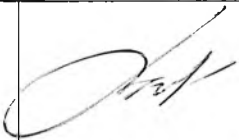



**WORKING DISCIPLINE PROGRAM**  
**CONTROL IN ORGANIZATIONAL SYSTEMS**

List of information about the working program of the discipline	Credentials
<b>Doctoral Program</b> <i>«Control in Organizational Systems»</i>	<b>Code DP</b> 2.3.4.
<b>Group of specialties</b> <i>«Information Sciences and Telecommunications»</i>	<b>Specialty group code</b> 2.3.
<b>Federal State Requirements (FSR)</b>	Order of the Ministry of Science and Higher Education of the Russian Federation No. 951 dated 20.10.2021
<b>Self- Approved Requirements (SAR)</b>	Order "On the implementation of the "Requirements for the development and implementation of training programs for scientific and scientific-pedagogical personnel in the graduate school of UrFU" No 315/03 dated 31.03.2022

Yekaterinburg  
 2023

**Working discipline program is compiled by the authors:**

No	Full name	Academic degree, academic title	Position	Department	Signature
1	Dmitry B. Berg	Doctor of Physical and Mathematical Sciences, Professor	Professor	Department of Big Data Analysis and Video Analysis Methods	
2	Svetlana N. Lapshina	Candidate of Technical Sciences, Docent	Associate Professor	Department of Systems Analysis and Decision Making	
3	Irina D. Turgel	Doctor of Economics Sciences, Professor	Head of Department	Department of Theory, Methodology and Legal support of State and Municipal Administration	

**Recommended:**  
**by Ural Federal University Academic Council**  
Protocol No. 9 dated 27.11.2023

Director of School of Economics and Management



Irina D. Turgel

**Agreed by:**

Head of the Department of  
Science and Pedagogical training



Elena A. Butrina

# **1. GENERAL CHARACTERISTICS OF THE DISCIPLINE "CONTROL IN ORGANIZATIONAL SYSTEMS"**

## **1.1 Abstract of the discipline content**

The program of the discipline "Control in organizational systems" reflects specialized topics related to the specialty **2.3.4 – Control in organizational systems**.

The program systematizes postgraduate students knowledge in the field of mathematical economics, statistical forecasting methods in economics, financial management, systems analysis and operations research, theory and methods of decision-making, management theory, mathematical programming, discrete optimization, information systems and technologies.

The discipline summarizes the knowledge obtained by postgraduate students in the course of preparation for the educational program "Control in organizational systems" and is the final course of the curriculum.

## **1.2 The language of discipline - English.**

## **1.3 Planned learning outcomes by discipline**

The result of training within the discipline is the formation of the following competencies in a postgraduate student:

- OPK-5 possession of scientific and subject area of knowledge;
- PC-1 system understanding of the current state, problems and role of control in organizational systems for improving the competitiveness of the country's economy;
- PC-2 ability to develop new mathematical methods for modeling objects and phenomena;
- PC-3 Ability to implement effective numerical methods and algorithms in the form of complex problem-oriented programs for conducting computational experiments;
- PC-4 Ability to conduct complex research of scientific and technical problems using modern technology of mathematical modeling and computational experiment;

As a result of mastering the discipline, the postgraduate student should:

**KNOW:**

- fundamentals of increasing competitiveness and improving the country's economic development;
- modern management methods and tools in organizational systems;
- approaches to the selection of effective numerical methods and algorithms in the form of problem-oriented software packages for conducting computational experiments;
- methods and means of complex research of scientific and technical problems using modern technology of mathematical modeling and computational experiment;
- specific activities in the management of social and economic systems, as well as in related areas.

**BE ABLE TO:**

- to diagnose the current state and problems in the field of control in organizational systems;
- conduct research in the field of control in organizational systems;
- apply effective numerical methods and algorithms in the form of complex problem-oriented programs for conducting a computational experiment;
- identify methods and tools for solving research problems;
- critically analyze, evaluate and synthesize new ideas in the management of social and economic systems.

**POSSESS:**

- skills to understand the current state, problems and role of control in organizational systems to improve the competitiveness of the country's economy;

- skills in conducting research in the field of control in organizational systems;
- developed the basis for effective numerical methods and algorithms in the form of complexes of problem-oriented programs for conducting a computational experiment;
- skills of conducting complex research of scientific and technical problems using modern;
- technology of mathematical modeling and computational experiment;
- skills in critical analysis, evaluation, and synthesis of new ideas.

#### **1.4 Legal framework of working discipline program**

##### **The working discipline program is based on:**

- Federal Law No. 273-FZ of December 29, 2012 "On Education in the Russian Federation";
- Federal Law No. 127-FZ of August 23, 1996 "On Science and the State Scientific and Technical Policy";
- Decree of the Government of the Russian Federation of November 30, 2021 No. 2122 "On approval of the Regulations on the training of scientific and scientific-pedagogical personnel in graduate school (adjuncture)";
- Order of the Ministry of Science and Higher Education of the Russian Federation dated February 24, 2021 No. 118 "On approval of the nomenclature of scientific specialties in which academic degrees are awarded, and on amendments to the Regulations on the Council for the Defense of Dissertations for the Candidate of Science degree, for the Doctor of Science degree, approved by order of the Ministry of Education and Science of the Russian Federation dated November 10, 2017 No. 1093";
- Order of the Ministry of Science and Higher Education of the Russian Federation dated October 20, 2021 No. 951 "On approval of federal state requirements for the structure of training programs for scientific and scientific-pedagogical personnel in graduate school (adjuncture), the conditions for their implementation, the timing of the development of these programs, taking into account various forms of education, educational technologies and features of certain categories of postgraduate students (adjuncts)";
- Regulations on the award of academic degrees in the Federal Autonomous State Educational Institution of Higher Education "Ural Federal University named after the first President of Russia B.N. Yeltsin" (Order No. 590/3 dated July 19, 2021);
- Requirements for the development and implementation of training programs for scientific and scientific-pedagogical personnel in the graduate school of UrFU (Order No. 315/03 dated March 31, 2022).

## 2. SCOPE OF DISCIPLINE AND KINDS OF ACADEMIC WORK

### 2.1 Distribution of hours of study sessions by term (according to the curriculum)

No	Types of study sessions	Scope of discipline		Distribution of discipline volume by semesters (hour)
		Total hours	Including contact work (hour)	
1.	Auditory lessons	4	4	4
2.	Lectures	4	4	4
3.	Practical lessons	0	0	0
4.	Independent work of postgraduate students, including all types of current attestation	104	0,6	104
5.	Intermediate attestation	E	1	E
6.	Total volume according to the curriculum, hour	108	5,6	108
7.	Total volume according to the curriculum, credits	3	-	3

## 3. CONTENT OF THE DISCIPLINE

### 3.1 The name of topics, their content, scope of lecture classes in hours

№	Section, discipline topic	Content	Type of study session, hours
1	<b>General questions of organizational systems management theory</b>	<p>Subject of management theory. Managerial relations and the concept of organizational management. Management goals. Goal tree. Specifics of working with target information. Performance criteria and limitations for 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 managing socio-economic systems: administrative-organizational, economic, socio-psychological, etc. Specifics of managing social and economic systems. Mathematical and simulation modeling. The role of man in the management of social and economic systems.</p> <p>A systematic approach to solving organizational management problems. Basic concepts of the system approach: system, element, structure, environment. System properties: integrity and articulability, connectivity, structure, organization and self-organization, integrated qualities. Organization as a system. Basic concepts of organizational sociology and social psychology: power, leadership, communication, authority, leadership styles.</p> <p>The concept of management functions and their classification, general and specific functions, strategic</p>	Lecture, 1 hour

		<p>planning in organizational management systems, tactical and operational planning, operational management, organization and information interaction, models and methods of decision-making, decision-making in conditions of risk and uncertainty, the use of expert assessments in decision-making, consulting activities in decision-making, psychological research. aspects of decision-making and implementation, features of collective decision-making, features of decision-making in emergency situations, negotiations and elections, personality and collective as objects of management.</p> <p>Society as a socio-economic system. Social structure of society, social institutions, their functions and interaction. Communication of organizational aspects of management. Principles and criteria for forming governance structures in socio-economic systems. The main types of organizational structures (linear, functional, combined, matrix), their evolution and development. Features of formation of program-target management structures at various levels of the hierarchy.</p>	
2	<p><b>Information technologies in organizational systems management</b></p>	<p>The concept of information, its properties and characteristics, features of using information about the state of the external environment and the control object in organizational control systems with feedback, features of creating and using information support for organizational management systems, information support in emergency situations.</p> <p>The concept of management efficiency. Methods for evaluating the performance and effectiveness of management. Problems of analysis and synthesis of mechanisms of functioning and management of socio-economic systems.</p> <p>Methods for obtaining and processing information for management tasks, expert procedures, and forecasting procedures.</p> <p>Preparation and adoption of management decisions. Automated management decision support systems.</p> <p>Computer technology and software in the management of socio-economic systems.</p> <p>Modeling method and its use in research and design of control systems. The concept of a model, classification of models. Boundaries and opportunities for 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.</p> <p>Economic and mathematical methods and models. Production functions. Leontiev, Arrow-Debre, Neumann-Gale models, etc.</p> <p>. Principles, models, methods and tools for designing and developing organizational systems.</p> <p>Management in complex systems, feedback and its role in management, entropy and information as characteristics of diversity and management, the principle of necessary diversity, individual and standard design of organizational systems, algorithmizing of management and data</p>	Lecture, 1 hour

		processing tasks, knowledge representation, design of data processing systems in organizational systems, information support of organizational systems, information languages and classifiers, software of organizational systems, its features, backup of software modules and information arrays, information security.	
3	<b>Mathematical foundations, models and methods of management of organizational systems</b>	<p>Methods of operations research and their scope for solving problems of management of socio-economic systems. Characteristics of the main problems of operations research related to queuing theory, queuing theory, and inventory management.</p> <p>Statement of mathematical programming problems. Optimization approach to the problems of managing socio-economic systems. A valid set and objective function. Forms for recording mathematical programming problems. Classification of mathematical programming problems.</p> <p>Linear programming problems. Statement and geometric interpretation of linear programming problems. Methods of linear programming. Direct and dual problems of mathematical programming. Simplex method. Multi-criteria linear programming problems.</p> <p>Models and numerical methods of unconditional optimization. Classification of unconditional optimization methods. Convergence rates. First-order methods. Gradient methods. Newton's method and its modifications. Quasi-Newtonian methods. Finite-difference methods. Zero-order methods: coordinate descent, Hook-Jeeves, conjugate directions, deformable configuration methods, simplex methods.</p> <p>Nonlinear 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 unconditional optimization. Methods of external and internal penalty functions. Combined design method and penalty functions. The mirror construction method. Sliding tolerance method.</p> <p>Stochastic programming problems. Stochastic quasi-gradient methods. Stochastic approximation methods. Methods with the averaging operation. Random search methods. Stochastic problems with natural probability constraints. Stochastic difference methods.</p> <p>Methods and problems of discrete programming. Problems of integer linear programming. Methods of Gomori clipping. The branch and border method. A task about assignments. Hungarian algorithm.</p> <p>Fundamentals of graph theory: definition of a graph, chains, cycles, paths, contours. Connected and strongly connected graphs. Adjacency matrix of the graph. Matrix of incidences of arcs and edges of graphs. Trees. Planar graphs. Shortest paths and polygons. Ford and Danzig algorithms. Circulation of maximum values and potentials of permutations. Maximum flow rate. Ford-Fulkerson</p>	Lecture, 2 hour

	<p>algorithm. Resource allocation problems on networks and graphs.</p> <p>Dynamic programming method for multi-step decision-making tasks. Bellman's optimality principle. Basic functional equation. Computational scheme of the dynamic programming method.</p> <p>Subject and basic concepts of game theory. Application of game theory to optimize management decisions. The concept of strategy and game solutions. Equilibria: in dominant strategies, maximin, Nash, Bayes, and Stackelberg. Matrix games. Games with consistent interests. Cooperative games.</p> <p>Setting up decision-making tasks. Stages of problem solving. Expert procedures. Methods for obtaining expert information. Measurement scales, methods of expert measurements. Methods of interviewing experts, characteristics of experts. Methods of processing expert information, assessing the consistency of expert opinions. Methods for multi-criteria evaluation of alternatives. Classification of methods. Sets of compromises and agreements, construction of sets. Utility function. Axiomatic methods of multi-criteria evaluation. Direct methods for multi-criteria evaluation of alternatives. Methods for normalizing criteria. Criteria priority characteristics. Postulated principles of optimality (uniformity, fair assignment, main criterion, lexicographic). Methods for approximating the utility function. Decision trees. Methods of compensation. Methods of analytical hierarchy. Methods of incomparability thresholds. Dialog methods of decision-making. Qualitative methods of decision-making (verbal analysis).</p> <p>Making decisions in the face of uncertainty. Types of uncertainty. Statistical models of decision-making. Bayes-Laplace, Hermeyer, Bernoulli-Laplace, Maximin (Wald), minimax risk criteria of Savage, Hurwitz, Hodges-Lehmann, etc.</p> <p>Making collective decisions. Arrow's theorem and its analysis. Rules of majority, Condorcet, and Borda. The Condorcet paradox. Distance in the relationship space. Modern concepts of group selection.</p> <p>Models and methods of decision-making with fuzzy information. Fuzzy sets. Basic definitions and operations on fuzzy sets. Fuzzy modeling. Problems of mathematical programming under fuzzy initial conditions. Fuzzy relationships, operations on relationships, and relationship properties. Making decisions with a fuzzy preference relationship based on a variety of alternatives. Making decisions with multiple preference relationships.</p> <p>Socio-economic forecasting. Tasks, role and types of forecasting, classification of forecasts by the purpose of forecasting, type of objects of forecasting, forecast horizon, scale of forecasting. 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</p>	
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	<p>methods for identifying trends. Algorithms for identifying trends. Models of growth curves in socio-economic forecasting. Main types of growth curves, methods of their selection and identification of parameters. Evaluating the quality of predictive models. Criteria for the quality of forecasts. Methods and models for detecting and analyzing periodic fluctuations in dynamic series. Statistical methods, filtering and analysis of spectra. Adaptive models and forecasting methods. Features of adaptive models, their types, and construction methods. Models of stationary and non-stationary time series, their types and methods of construction.</p> <p>Fundamentals of the theory of active systems. Concepts of an active system and its functioning mechanism. Scheduling mechanisms in active systems. Non-manipulability of planning procedures. The principle of open management and the optimality of correct management mechanisms. Incentive mechanisms in deterministic active systems and active systems with uncertainty. Consistency of the optimal solution. Basic mechanisms for resource allocation, active expertise, competitive, multi-channel, cost-effective. Problems and methods of identification of organizational systems based on retrospective, current and expert information, taking into account the activity of managed entities. Methods for modeling the functioning mechanisms of active systems. Simulation games are a tool for studying organizational mechanisms and a method of active learning.</p> <p>Project management. Specifics 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 intra-company management.</p> <p>Human resource control in organizational systems. Management goals and objectives, workforce planning, recruitment, training and placement of personnel, assessment of business qualities of management personnel, use of labor resources, management working styles, conflict situations, requirements for management personnel in emergency situations.</p> <p>Tasks and methods of financial analysis. Accrual and discounting. Effective bid. Payment flows. Financial equivalence of obligations. Typical applications. Credit calculations. Evaluation of investment processes. Selection of investment projects. Financial calculations on the securities market. Mathematical foundations of financial analysis under conditions of risk and uncertainty. Risks and their measures. Utility function. Optimal securities portfolio problem. Models of risk portfolio optimization problems.</p>	
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### 3.2 Practical lessons

Not provided

### 3.3 Approximate theme of independent work

Not provided

## **4. ORGANIZATION OF PRACTICE AND SELF-STUDY WORK**

### **4.1 Laboratory work**

Not provided

### **4.2 Practical lessons**

Not provided

### **4.3 Sample topics of independent work**

#### **4.3.1 Sample list of homework topics**

1. Characteristics of information sources used in the study of the section " General issues of organizational systems management theory.
2. Characteristics of information sources used in the study of the section "Information technologies in the management of organizational systems".
3. Characteristics of information sources used in studying the section Mathematical foundations, models and methods of managing socio-economic systems.

### **4.4 Sample list of topics for research papers (essays, creative works)**

#### ***Section 1.***

1. General questions of the theory of management of organizational systems (applied to the object of dissertation research).
2. General questions of organizational systems management theory (applied to a specific organizational system of a region / country/company).

#### ***Section 2.***

1. Information technologies in the management of organizational systems (applied to the object of dissertation research).
2. Information technologies in the management of organizational systems (applied to a specific organizational system of a region/country/company).

#### ***Section 3.***

1. Mathematical foundations, models and methods of management of organizational systems (applied to the object of dissertation research).
2. Mathematical foundations, models and methods of managing organizational systems (applied to a specific socio-economic system of a region / country/company).

## 5. FUND OF EVALUATION FOR THE CURRENT AND INTERIM CERTIFICATION OF THE DISCIPLINE

### 5.1 Criteria for evaluating the results of control and evaluation activities of the current and intermediate discipline attestation

The evaluation criteria for the results of current and intermediate attestation Approved evaluation criteria of the achievements are based on three levels of mastering the competence components: intermediate, advanced, and high.

Competence components	Characteristics of the level of development the components of competencies		
	Threshold	Advanced	High
<b>Knowledge</b>	A postgraduate student demonstrates knowledge-acquaintance, knowledge-copy: he recognizes objects, phenomena and concepts, finds differences in them, knows of the sources of information, can independently reproduce knowledge.	A postgraduate student demonstrates analytical knowledge: confidently reproduces and understands the acquired knowledge, classifies them into one or another classification group, independently systematizes them, establishes relationships between them, productively applies in common situation.	A postgraduate student can independently get new knowledge from the world around him, creatively use it to make decisions in new and nonstandard situations.
<b>Skills</b>	A postgraduate student is able to correctly perform prescribed actions according to an instruction, an algorithm in a known situation, independently solve typical problems that require a choice from known methods in a predictably changing situation.	A postgraduate student is able to independently solve nonstandard tasks that require a choice based on a combination of known methods in an unpredictably changing situation.	A postgraduate student is able to independently solve research problems, demonstrates the creative use of skills (technologies).
<b>Personal qualities</b>	A postgraduate student has a low motivation for studying, shows an indifferent, irresponsible attitude to learning, and assigned work	A postgraduate student has a pronounced motivation for studying, demonstrates a positive attitude towards learning and future work, and is active.	A postgraduate student has a developed motivation for studying and work activities, shows perseverance and dedication, diligence, independence, and creativity.

## **5.2 Evaluation tools for current and intermediate attestation**

Assessment of knowledge, skills and (or) experience that characterize step-by-step formation of competencies in the discipline " Control in Organizational Systems " is carried out in the form of current control and intermediate attestation.

### **5.2.1 Sample tasks for conducting mini-tests as part of training sessions**

Not provided

### **5.2.2 Sample control tasks during training sessions**

Not provided

### **5.2.3 Sample control cases**

Not provided

### **5.2.4 List of sample test questions**

Not provided

### **5.2.5 List of sample questions for the exam**

1. Subject of management theory. Managerial relations and the concept of organizational management.
2. Management goals. Goal tree. Specifics of working with target information. Performance criteria and limitations for achieving the goal.
3. Management in complex systems. The concept of feedback and its role in management. Formalization and formulation of management tasks.
4. Basic structures and methods of managing socio-economic systems: administrative-organizational, economic, socio-psychological, etc. Specifics of managing social and economic systems.
5. Mathematical and simulation modeling. The role of man in the management of social and economic systems.
6. A systematic approach to solving organizational management problems. Basic concepts of the system approach: system, element, structure, environment. System properties: integrity and articulability, connectivity, structure, organization and self-organization, integrated qualities.
7. Organization as a system. Basic concepts of organizational sociology and social psychology: power, leadership, communication, authority, leadership styles.
8. 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 information interaction.
9. Models and methods of decision-making, decision-making in conditions of risk and uncertainty, the use of expert assessments in decision-making, consulting activities in decision-making, psychological aspects of decision-making and implementation, features of collective decision-making, features of decision-making in emergency situations, negotiations and elections, the individual and the team as objects of management.
10. Society as a socio-economic system. Social structure of society, social institutions, their functions and interaction. Communication of organizational aspects of management.
11. Principles and criteria for forming governance structures in socio-economic systems. The main types of organizational structures (linear, functional, combined, matrix), their evolution and development. Features of formation of program-target management structures at various levels of the hierarchy.
12. The concept of information, its properties and characteristics, features of using information about the state of the external environment and the control object in organizational control systems with feedback, features of creating and using information support for organizational management systems, information support in emergency situations.

13. The concept of management efficiency. Methods for evaluating the performance and effectiveness of management. Problems of analysis and synthesis of mechanisms of functioning and management of socio-economic systems.
14. Methods for obtaining and processing information for management tasks, expert procedures, and forecasting procedures.
15. Preparation and adoption of management decisions. Automated management decision support systems. Computer technology and software in the management of socio-economic systems.
16. Modeling method and its use in research and design of control systems. The concept of a model, classification of models. Boundaries and opportunities for formalizing procedures for managing social and economic systems.
17. System models: static, dynamic, conceptual, topological, formalized (procedures for formalizing system models), informational, logical-linguistic, semantic, set-theoretic, etc.
18. Economic and mathematical methods and models. Production functions. Leontiev, Arrow-Debre, Neumann-Gale models, etc.
19. Management in complex systems, feedback and its role in management, entropy and information as characteristics of diversity and management, the principle of necessary diversity, individual and standard design of organizational systems, algorithmization of management and data processing tasks, knowledge representation, design of data processing systems in organizational systems, information support of organizational systems.
20. Information languages and classifiers, software of organizational systems, its features, redundancy of software modules and information arrays, information security.
21. Methods of operations research and the scope of their application for solving problems of managing socio-economic systems. Characteristics of the main problems of operations research related to queuing theory, queuing theory, and inventory management.
22. Statement of mathematical programming problems. Optimization approach to the problems of managing socio-economic systems. A valid set and objective function. Forms for recording mathematical programming problems. Classification of mathematical programming problems.
23. Linear programming problems. Statement and geometric interpretation of linear programming problems. Methods of linear programming. Direct and dual problems of mathematical programming. Simplex method. Multi-criteria linear programming problems.
24. Models and numerical methods of unconditional optimization. Classification of unconditional optimization methods. Convergence rates. First-order methods. Gradient methods. Newton's method and its modifications. Quasi-Newtonian methods. Finite-difference methods. Zero-order methods: coordinate descent, Hook-Jeeves, conjugate directions, deformable configuration methods, simplex methods.
25. Nonlinear 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 unconditional optimization. Methods of external and internal penalty functions. Combined design method and penalty functions. The mirror construction method. Sliding tolerance method.
26. Stochastic programming problems. Stochastic quasi-gradient methods. Stochastic approximation methods. Methods with the averaging operation. Random search methods. Stochastic problems with natural probability constraints. Stochastic difference methods.
27. Methods and problems of discrete programming. Problems of integer linear programming. Methods of Gomori clipping. The branch and border method. A task about assignments. Hungarian algorithm.
28. Fundamentals of graph theory: definition of a graph, chains, cycles, paths, contours. Connected and strongly connected graphs. Adjacency matrix of the graph. Matrix of incidences of arcs and edges of graphs. Trees. Planar graphs. Shortest paths and polygons. Ford and Danzig

algorithms. Circulation of maximum values and potentials of permutations. Maximum flow rate. Ford-Fulkerson algorithm. Resource allocation problems on networks and graphs.

29. Dynamic programming method for multi-step decision-making tasks. Bellman's optimality principle. Basic functional equation. Computational scheme of the dynamic programming method.

30. Subject and basic concepts of game theory. Application of game theory to optimize management decisions. The concept of strategy and game solutions. Equilibria: in dominant strategies, maximin, Nash, Bayes, and Stackelberg. Matrix games. Games with consistent interests. Cooperative games.

31. Setting up decision-making tasks. Stages of problem solving. Expert procedures. Methods for obtaining expert information. Measurement scales, methods of expert measurements. Methods of interviewing experts, characteristics of experts. Methods of processing expert information, assessing the consistency of expert opinions.

32. Methods for multi-criteria evaluation of alternatives. Classification of methods. Sets of compromises and agreements, construction of sets. Utility function. Axiomatic methods of multi-criteria evaluation. Direct methods for multi-criteria evaluation of alternatives. Methods for normalizing criteria. Criteria priority characteristics. Postulated principles of optimality (uniformity, fair assignment, main criterion, lexicographic). Methods for approximating the utility function. Decision trees. Methods of compensation. Methods of analytical hierarchy. Methods of incomparability thresholds. Dialog methods of decision-making. Qualitative methods of decision-making (verbal analysis).

33. Making decisions in the face of uncertainty. Types of uncertainty. Statistical models of decision-making. Bayes-Laplace, Hermeyer, Bernoulli-Laplace, Maximin (Wald), minimax risk criteria of Savage, Hurwitz, Hodges-Lehmann, etc.

34. Making collective decisions. Arrow's theorem and its analysis. Rules of majority, Condorcet, and Borda. The Condorcet paradox. Distance in the relationship space. Modern concepts of group selection.

35. Models and methods of decision-making with fuzzy information. Fuzzy sets. Basic definitions and operations on fuzzy sets. Fuzzy modeling. Problems of mathematical programming under fuzzy initial conditions. Fuzzy relationships, operations on relationships, and relationship properties. Making decisions with a fuzzy preference relationship based on a variety of alternatives. Making decisions with multiple preference relationships.

36. Socio-economic forecasting. Tasks, role and types of forecasting, classification of forecasts by the purpose of forecasting, type of objects of forecasting, forecast horizon, scale of forecasting. Assessment of the reliability of forecasting.

37. 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. Models of growth curves in socio-economic forecasting. Main types of growth curves, methods of their selection and identification of parameters.

38. Evaluating the quality of predictive models. Criteria for the quality of forecasts. Methods and models for detecting and analyzing periodic fluctuations in dynamic series.

39. Statistical methods, filtering and analysis of spectra. Adaptive models and forecasting methods. Features of adaptive models, their types, and construction methods. Models of stationary and non-stationary time series, their types and methods of construction.

40. Fundamentals of the theory of active systems. Concepts of an active system and its functioning mechanism. Scheduling mechanisms in active systems. Non-manipulability of planning procedures. The principle of open management and the optimality of correct management mechanisms. Incentive mechanisms in deterministic active systems and active systems with uncertainty.

41. Consistency of the optimal solution. Basic mechanisms for resource allocation, active expertise, competitive, multi-channel, cost-effective.

42. Problems and methods of identification of organizational systems based on retrospective, current and expert information, taking into account the activity of managed entities. Methods for modeling the functioning mechanisms of active systems. Simulation games are a tool for studying organizational mechanisms and a method of active learning.

43. Project management. Specifics 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 intra-company management.

44. Human resource control in organizational systems. Management goals and objectives, workforce planning, recruitment, training and placement of personnel, assessment of business qualities of management personnel, use of labor resources, management working styles, conflict situations, requirements for management personnel in emergency situations.

45. Tasks and methods of financial analysis. Accrual and discounting. Effective bid. Payment flows. Financial equivalence of obligations. Typical applications. Credit calculations. Evaluation of investment processes. Selection of investment projects. Financial calculations on the securities market. Mathematical foundations of financial analysis under conditions of risk and uncertainty. Risks and their measures. Utility function. Optimal securities portfolio problem. Models of risk portfolio optimization problems.

## **6. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE**

### **6.1 Recommended literature**

#### **6.1.1 Main literature**

1. Burkov V. N. et al. Introduction to theory of control in organizations. – CRC Press, 2015. – T. 10.
2. Chenhall R. H. Management control systems design within its organizational context: findings from contingency-based research and directions for the future //Accounting, organizations and society. – 2003. – T. 28. – №. 2-3. – C. 127-168.
3. Dahleh M. A., Diaz-Bobillo I. J. Control of uncertain systems: a linear programming approach. – Prentice-Hall, Inc., 1994.
4. Dermer J. Control and organizational order //Accounting, Organizations and Society. – 1988. – T. 13. – №. 1. – C. 25-36.
5. Flamholtz E. Effective organizational control: A framework, applications, and implications //European Management Journal. – 1996. – T. 14. – №. 6. – C. 596-611.
6. Hill R. The case of the missing organizations: co-operatives and the textbooks //The Journal of Economic Education. – 2000. – T. 31. – №. 3. – C. 281-295.
7. MacCarthy B. Organizational, systems and human issues in production planning, scheduling and control //Handbook of production scheduling. – 2006. – C. 59-90.
8. Rockness H. O., Shields M. D. Organizational control systems in research and development //Accounting, Organizations and Society. – 1984. – T. 9. – №. 2. – C. 165-177.
9. Watkins L. R., Mayer D. J. Organization of endogenous opiate and nonopiate pain control systems //Science. – 1982. – T. 216. – №. 4551. – C. 1185-1192.

#### **6.1.2. Additional literature**

1. Alvermann D. E. The role of textbooks in teachers' interactive decision making //Literacy Research and Instruction. – 1987. – T. 26. – №. 2. – C. 115-127.
2. Colson G., De Bruyn C. Models and methods in multiple objectives decision making //Models and methods in multiple criteria decision making. – Pergamon, 1989. – C. 1201-1211.
3. Hutchinson T., Torres E. The textbook as agent of change. – 1994.
4. Orasanu J., Connolly T. The reinvention of decision making //Decision making in action: Models and methods. – 1993. – T. 1. – C. 3-20.

5. Zimmerman J. L., Yahya-Zadeh M. Accounting for decision making and control //Issues in Accounting Education. – 2011. – T. 26. – №. 1. – C. 258-259.

## **6.2 Methodological manuals**

Not used

## **6.3 Software**

Not used

## **6.4 Databases, information and reference systems and search engines**

1. Google scholar - <https://scholar.google.ru/>
2. Scopus - <https://www.scopus.com/>
3. ScienceDirect - [www.sciencedirect.com](http://www.sciencedirect.com)
4. eLibrary - <http://elibrary.ru/>

## **6.5 Electronic educational resources**

1. Zonal scientific library <http://lib.urfu.ru/course/view.php?idM67>
2. UrFU electronic resources <http://lib.urfu.ru/mod/data/view.php?id-2802>
3. Library catalogue <http://lib.urfu.ru/course/view.php?idM81>.

## **7. MATERIAL AND TECHNICAL SUPPORT OF THE DISCIPLINE**

Ural Federal University has special rooms for lecture-type classes, group and individual consultations, current control and intermediate attestation, as well as rooms for independent work, equipped with computers with the access to the Internet and electronic information educational environment, and facilities for storage and preventive maintenance of equipment. Postgraduate students of the departments are provided with special rooms for research work.