

CLAIM:
Director
Institute of Cybernetics

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THE BASIC PROGRAM OF THE DISCIPLINE
METHODS OF OPTIMIZATION

DIRECTION of the PLO **09.04.01 Informatics and computer engineering**

PROFILES of computer networks and telecommunications, computer analysis and interpretation of data, microprocessor systems, Distributed Systems, information and software systems

QUALIFICATIONS (degree of) **master**
BASIC TRAINING ENROLMENT PLAN **2015 y.**
COURSE **1** -SEMESTER **1**
NUMBER of CREDITS **3 ECTS credits**
DISCIPLINE CODE **M1. BM22.**

Types of training activities	Temporary full-time learning resource
Lectures, hours	16
Practical exercises, h	
Laboratory exercises, hours	32
Classroom training, h	48
Independent work, h	60
Total h	108

VIEW the INTERMEDIATE CERTIFICATION **exam (1 St semester)**,

That UNIT **Department of IPS**

CHAIR Of IPS **Son'kin Ma**

PLO LEADER **Kim V.I.**

Associate PROFESSOR **Rejzlin V.i.**

1. The objectives of the DEVELOPMENT of DISCIPLINE

Objectives of discipline are:

- development of numerical methods for continuous optimization of the students;
- skills independent study of the disciplines and solutions to common tasks;
- acquisition of skills in the modern integrated systems programming for numerical optimization methods;
- assimilation of knowledge by students, as well as the formation of their motivation to educate themselves by fostering independent learning activities.

Its objectives are fully in line with the objectives of (C1-C5) the PLO.

2. PLACE DISCIPLINE in the structure of the PLO

The optimization methods of discipline "(B4) M1. is the basic discipline of general academic cycle.

For successful mastering of necessary basic and special knowledge when studying the PLO Bachelor training in "computer science and computer engineering, information systems and technology, and related it areas: **knowledge** basic concepts of mathematics and computer science, role modeling and numerical methods in science and technology; **skills** applied computing for solving practical tasks in **ladeniâ** PC skills and create professional software products.

Korekvizitami are discipline training in English (B2 M1.),. "Software development technology (M1. B5).

3. The results of the DEVELOPMENT of DISCIPLINE

In accordance with the requirements of the PLO development discipline directed to the formation of the students the following competencies (learning outcomes), including under the GEF:

Components of the learning outcomes to be derived when studying this discipline

Results learning (competence of the GEF)	Components of the learning outcomes					
	Code	Knowledge	Code	Skills	Code	Possession of experience
P1 (CA-1, CA-2 OK-6 PK-1, PK-5)	Z. 1.1	Optimization methods and making design decisions; the basic theory of the numerical methods for continuous improvement; implementation of the optimization algorithms using computers.	W. 1.1	To optimizaciõnnuâ problem and its solution algorithm design; use optimization techniques to solve scientific and engineering problems.	V. 1.1	Methods of making design decisions; the main methods of solution of non-stuttering optimization problems; skills development and debugging of programs to meet the challenges of continuous improvement.

As a result of the optimization Methods of discipline "a student must have achieved the following results:

Expected results development of discipline

No. p/p	The result
RD1	development of continuous improvement of numerical methods students
RD2	skills independent study of the discipline and resolve common tasks
RD3	acquisition of skills in the modern integrated systems programming for numerical optimization methods
Rd4	assimilation of knowledge by students, as well as the formation of their motivation to educate themselves by fostering independent learning activities

4. The structure and content of the DISCIPLINE

Section 1. Introduction

An annotated table of contents sections of courses:

- 1.1. Mathematical model of object and its properties. Setting targets for optimization.
- 1.2. the notion of optimality criteria and objectives.
- 1.3. the main tasks of optimization.
- 1.4. classification of optimization problems.

List of laboratory works under section:

Tabulation features. (Input control)

Section 2. 1-dimensional optimization

An annotated table of contents sections of courses:

- 2.1. the methods of narrowing the range of uncertainty. General search method. The dichotomy. The method of "golden section".
- 2.2. method of localization of the extremum.
- 2.3. Newton's methods: Newton-Raphson, kvazin'ûtonovskij method.

List of laboratory works under section:

Extremum search using the General search.
Methods of dichotomies, the golden section.
Methods to find extremum N'ûtonovskogo type.

Section 3. Multidimensional absolute optimization

An annotated table of contents sections of courses:

- 3.1. example of multidimensional optimization tasks. Relief is function.
- 3.2. the method of descent-wise. Method of ravines.
- 3.3. Gradient methods. The speedy descent.
- 3.4. The Newton method, Markvardta method.

List of laboratory works under section:

Multidimensional optimization. Tasks without restrictions. A gradient method.
Methods of rapid descent, Markvardta.

Section 4. Conditional optimization

An annotated table of contents sections of courses:

4.1. Tasks with constraints. Search the optimum type constraints in problems with PARS. Lagrange Multipliers. The method of Lagrange multipliers uncertain.

4.2. the search for the optimum in problems with constraints of inequality type. A method of penalty functions.

4.3. Method of factors.

4.4. methods of random search.

List of laboratory works under section:

Conditional optimization, the method of penalty functions.

Method of factors.

Section 5. Linear programming

An annotated table of contents sections of courses:

5.1. Examples of tasks for linear programming.

5.2. Basic definitions. The main problem of linear programming.

5.3. the main problem of linear programming with restrictions-inequalities.

5.4. The geometric interpretation of linear programming problems. The main theorem.

5.5. Simplex-method for solving linear programming problems.

List of laboratory works under section:

Linear programming tasks.

6. Organization and educational and methodological providing of INDEPENDENT WORK of STUDENTS

6.1. the types and forms of independent work

Independent work of students includes the current issue-oriented and creative independent work (TCP).

The current CCF aims at deepening student's knowledge, and the development of practical skills and includes:

the lecture material, preparation for laboratory work, practical exercises with the use of network educational resource (portal site Department of TPU, IPS);

leading independent work; homework; the study of the independent study; preparing for the tests, exam, the course work.

Creative independent work includes:

Search, analysis, structuring of information on term paper.

6.3. control of independent work

Landmark control as control works on theoretical and practical training, as well as during the Conference on current work weeks depending upon the acquisition of oral and written communication skills.

Based on the results of the current and final assessment of control a student's admission to the exam. The exam is oral. Evaluation of the coursework is based on analysis of the regularity and systematic work of the student (in accordance with the Rating plan).

6.4. the educational and methodological providing of independent work of students

And students network educational resources are provided in the CAF website, TPU. IPS, network, Internet, and other scientific and educational resources.

7. the CURRENT and INTERIM ASSESSMENT of QUALITY of DISCIPLINE

Evaluation of quality of discipline is based on the following control measures:

Control activities	Learning outcomes for the discipline
<i>performance and protection of laboratory work</i>	RD1-Rd4
<i>testing</i>	
<i>exam</i>	

To assess the quality of discipline in conducting regulatory activities provides the following tools (Fund evaluation tools):

- control questions during parries and laboratory work;
- the test questions;
- issues for examination:

1. mathematical model of object and its properties.
2. the notion of optimality criteria and objectives.

3. the main tasks of optimization.
4. the 1-dimensional optimization. General search method. Unimodal'nye function. A method of dividing the interval in half.
5. the Unimodal'nye function. The method of "golden section".
6. method of search of Svenna contains the minimum.
7. the 1-dimensional optimization. Newton-Raphson
8. the 1-dimensional optimization. Kvazin'ûtonovskij method.
9. Multidimensional optimization. Relief is function. The wise of the descent.
10. Method of ravines. Random search.
11. Multidimensional optimization. A gradient method. Method of steepest descent.
12. Multidimensional optimization. Newton's Method.
13. Multidimensional optimization. Markvardta Method.
14. the tasks with constraints. Search the optimum type constraints in problems with PARS. The method of Lagrange multipliers uncertain.
15. Find the optimum in problems with constraints. Methods of penalty and barrier functions.
16. the search for the optimum in problems with constraints. Method of factors.
17. linear programming. Setting objectives. The main task and's (canonical) bringing to it an arbitrary task.
18. linear programming. Basic conversion tasks to the main task of the LP with restrictions-inequalities (form a).
19. linear programming. Geometrical solution of two-dimensional problems. The main theorem on the LP.

8. the RATING of QUALITY of DISCIPLINE

Evaluation of quality of discipline during the current and the intermediate certification training is carried out in accordance with the guidance on the current control performance, intermediate and final appraisal students of Tomsk Polytechnic University ", approved by the Rector's order No. 77/ml from November 29, 2011.

In accordance with the schedule of the discipline ":

- current certification (quality assessment of theoretical material (responses to questions, etc.) and the results of practical activities (tasks, tasks, problems, etc.) is produced during the term (evaluated in points (maximum 60 points), by the end of the semester, the student must score at least 33 points);
- intermediate certification (exam, test) is performed at the end of the semester (evaluated in points (maximum 40 credits), exam (competition), the student must score at least 22 points).

Overall rating for the discipline is determined by summing the points earned during the current and the intermediate certifications. Maximum overall rating corresponds to 100 points.

In accordance with the schedule of the course of the project (work) ":

- current certification (assessment of quality performance parts, etc.) is produced during the term (evaluated in points (maximum 40 points), by the end of the semester, the student must score at least 22 points);

- intermediate certification (protection project (work)) is made at the end of the semester (evaluated in points (maximum 60 points), on the protection of the student must score at least 33 points).

9. The educational-methodical and information ENSURING DISCIPLINE

• main references:

1. Rejzlin V.i. Numerical optimization methods: manual. -Tomsk: IZD-vo TPU, 2013-105 c.
2. Mikhail Lesin, Victor VASILEVICH. The basics of optimization methods: study guide/v. Lesin, y. p. Lisovets. -3 ed., Corr. — St.p.: LAN, 2011. -342 with.
3. Attetkov Alexander Vladimirovich. Optimization techniques: study guide/a. Attetkov, v. n. Zarubin, a. n. Kanatnikov. -Moscow: infra-m DR., 2012. -270 c.
4. Kočegurova EA. The theory and techniques of optimization [electronic resource]: the manual. -Tomsk: Publishing House of TPU, 2013. Access map: <http://www.lib.tpu.ru/fulltext2/m/2013/m234.pdf>

• further reading:

1. Fedunec, Nina Ivanovna. Optimization techniques: a training manual for high schools/n. i. Fedunec, y. v. Chernikov; Moscow State Mining University (MSMU). -Moskva: IZD-vo MSMU, 2009. -375 with.
2. Victor A. Goncharov. Optimization techniques [electronic resource]: tutorial/VA Goncharov; National Research University, Moscow Institute of electronic technology (ELECTRONIC TECHNOLOGY). -Access Scheme: <http://www.lib.tpu.ru/fulltext2/m/2014/FN/fn-01.pdf>
3. Alexei Grigoryevich D.l.horvata V.a.gluharev. Optimization techniques: tutorial and workshop/a. g. Sukharev, a. timokhov, v. Fedorov; Moscow State University. M. V. Lomonosov Moscow State University (Msu). -3 ed., Corr. and additional charge. -Moscow: Harvard Business Press, 2014. — 367 p.
4. Sofieva, Julia. Conditional optimization: methods and objectives/y. m. Sofieva, a. m. Zirlin. -Ed. 2. -Moscow: Librokom, 2012. -143 s.

• software and Internet-resources:

Operating system : Windows Vista, Windows 7 Corporative.

CREDA programming Visual Studio 2013, Borland C ++ Builder for Windows Version 10 (Turbo C++).

Electronic textbook: V.i. Rejzlin. Methods of optimization. TPU, Tomsk:

<http://109.123.146.125/>

Optimization-From Wikipedia: [http://en.wikipedia.org/wiki/Optimization_\(mathematics\)](http://en.wikipedia.org/wiki/Optimization_(mathematics))

10. The logistics DISCIPLINE

Laboratory works are carried out in computer classes equipped with 16-û computers based on the Intel Core 2 Duo.

Computer classes (Sovetskaya str., 84/3, Oud. 407a, 407b-IR)	Computers Pentium ® Core™ 2 processor 1, 6 GHz (20 PCs.), LCD monitors 17 inch Acer (20 PCs.) The CNet network switch 16 ports
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The program is based on the standard TPU PLO in accordance with the requirements of the GEF in 09.04.01 “Informatics and computer science”.

The program was approved at the meeting of Department of Informatics and systems design

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