Syllabus of discipline
"OPTIMIZATION METHODS "

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Expected learning outcomes.
As a result of studying the discipline, the student
should know:

- unconditional optimization methods for functions of one and many variables,
- methods of conditional optimization,
- methods for solving linear programming problems,
- optimization processes in solving problems of graph theory,
- methods of convex and multi-criterion optimization;

be able:

- perform formulation, algorithmization, and solution of the main types of optimization problems (solving problems by different methods of one-dimensional optimization, multidimensional optimization, etc.)
- use modern application and program packages (including Maple 2020) when solving practical problems

Capacity: 4 ECTS credits (30 hours of classes, 60 hours of self-study, exam).

Objective: To study modern mathematical methods for solving problems of optimization of various control systems and numerical methods and algorithms for their implementation on computers**.**

The subject of the discipline. Quantitative and qualitative methods of mathematical and numerical analysis of optimization problems

Originality of the discipline: Author's course.

The content of the discipline

MODULE 1. LINEAR PROGRAMMING METHODS

Topic 1. Facts from history and ancient optimization problems. The basic algorithm for solving a typical optimization problem. Linear programming, general pain. The general algorithm of the simplex method.

Topic 2. Finding the extremum of a linear objective function under conditions of constraints on variables. An example of a typical linear programming problem and its solutions. The concept of the simplex method. The issue of optimal distribution of funds

Topic 3. Basic concepts of graph theory. A typical transport problem and methods of its solution in the form of a weighted graph

Topic 4. Some features of the GraphTheory software package. Optimization of traffic (resource turnover) in the logistics network. Simple logistics network. An example of a more complex (random) logistics network.

Topic 5. The shortest (optimal) paths on the graphs. Unweighted graphs. Dijkstra's algorithm for weighted graphs. The classic problem of a salesman and the algorithm for its solution. Optimal tour.

MODULE 2. NONLINEAR PROGRAMMING

Topic 6. Nonlinear optimization problems: simple examples. Economic-mathematical nonlinear optimization problems. The issue of optimal investment. Production function as a nonlinear target.

Topic 7. Engineering problems of nonlinear optimization. The issue of optimizing the geometry of a welded joint. The problem of mass optimization and design of a helical steel spring.

Topic 8. Problem 0/1 cargo officer. Optimized backpack (container). Math formulation of the problem and the scope of its application. Approximate solution: "greedy" algorithm. Exact solution: the concept of the method of dynamic programming

Topic 9. Methods of effective optimization: DirectSearch software package. Numerical optimization with constraints and its accuracy. Optimization of objective functions with variables of a different type. Search for global and local extremes.

Topic 10. Methods of multicriteria optimization. Examples of multicriteria optimization of vector objective functions.

MODULE 3. WORKSHOP

Topic 11. Research and visualization of areas of good plans. Purpose: construction and visualization using Maple areas of implementation of constraints imposed on target functions.

Topic 12. Research of lines of the same level for objective functions. Purpose: construction and subsequent analysis of lines of the same level for target functions by Maple software.

Topic 13. Research of path optimization on graphs and topological sorting. Purpose: the practice of topological sorting and determination of optimal paths on large-scale random graphs. Traffic optimization for a random network.

Topic 14. An example of a logistics problem with a vector objective function. Purpose: to study the methods of solving problems with vector objective functions. DirectSearch software package and its features

Topic 15. Test task and its performance.

Prerequisites

Philosophy, Mathematics, Informatics, Mathematical modeling, Foreign language (English).

Post requisites

The knowledge gained during the study of the discipline can be used to solve manufacturing and/or business problems that require optimization.

Semester control: exam.

Evaluation:

For the semester: 60 points

For credit: 40 points

Types of activities:

Testing after lectures. Seminars. Defense of the technical task on an individual topic. Presentations and reports on the implementation of team project tasks.

Technical support

Projection multimedia equipment (projector, screen, computer).

Computer class with Internet access and licensed software packages: Windows 10, Microsoft Office 2019, MAPLE 2020

Moodle e-learning system 3.9.

Deadline policy

Works submitted in violation of deadlines without good reason are evaluated with a lower grade.

The policy of academic integrity

Provides self-verification with authentication through a Google account and completion of a project project task on an exclusive topic. Write-off during offset (including using mobile devices) is prohibited. In case of detection of plagiarism or write-off of works are not credited.

Criteria for evaluating individual works:

Knowledge of theoretical lecture material. Knowledge of the requirements for the development of the technical task and the ability to perform them. Knowledge and skills of work in the environment of design and modeling or frameworks.