



# **MECHANICS OF MATERIALS AND ENGINEERING STRUCTURES**

**English language**

**MASTER'S PROGRAMME DEGREE**



## PROGRAM ADVANTAGES

- ✓ In-depth knowledge in the field of materials mechanics allows graduates to apply the acquired skills in various industries: construction, mechanical engineering, design of ground infrastructure for airports and spaceports, etc.
- ✓ Knowledge of the specifics of the design of engineering structures determines the demand for graduates in design organizations and at construction sites.
- ✓ Feature of training - a large number of individual and group assignments.
- ✓ Lectures and master classes by invited Russian and foreign experts are held regularly.
- ✓ This program is implemented by the leading specialists of the Academy, and it is aimed at training qualified specialists who can quickly and accurately solve the problems of their training.





# STUDYING PROCCESS

**120** credits.

Lectures, practical classes and independent work, several types of practice: research, technological, pedagogical, pre-diploma.



## METHODS OF SOLID MECHANICS IN STRUCTURAL ANALYSIS

- General theory of deformations and stresses, tensors in three-dimensional Euclidean space, determination of displacements by a given deformation, theory of stresses, curvilinear, cylindrical and spherical coordinates, theory of elasticity, elastic body, Hooke's law for isotropic bodies, problems of elasticity theory, equations of elasticity in displacements and in stresses, Clapeyron's and Maxwell's theorems, solution of a plane problem in stresses and displacements, torsion of prismatic rods, bending of plates, variational principles of elasticity theory, Lagrange's principle, Castigliano's principle, Reissner's functional, differential-difference method, finite element method, ideal plasticity, elastic-plastic and rigid-plastic body, plane stress state, theories of creep, creep and stress relaxation, equations of mechanics of a deformable solid, variational principles of deformation mechanics, statics of plates and shells, nonlinear problems of mechanics of a deformable solid.



## SPECIAL SECTIONS OF HIGHER MATHEMATICS

- Differential equations, reduction of equations to canonical form, concept of setting boundary and initial conditions, d'Alembert method, correct statement of the problem, solution of the problem of vibrations of a bounded string by Fourier methods, boundary value problems for trigonometric functions, wave equation.



## LINEAR SHELL THEORY

- The geometry of thin elastic shells, the first and second quadratic forms of surfaces, parametric, explicit and implicit forms of specifying surfaces, moment and momentless theories of thin elastic shells, equilibrium equations, physical equations, equations of continuity of deformations, internal forces and moments, boundary conditions in the theory of shells.



## **MATHEMATICAL MODELING**

- Linear programming models, nonlinear models, dynamic programming models, optimization models (formulation of the optimization problem), mathematical modeling in the problems of studying the stress-strain state of structures, tools for creating mathematical models, applying mathematical approaches to solving practical, engineering problems, analytical and computational mathematical methods for solving applied engineering problems.



## **COMPUTER-AIDED DESIGN SYSTEMS FOR BUILDINGS AND INDIVIDUAL STRUCTURAL ELEMENTS**

- Computer-aided design (CAD) systems, structural design, computer-aided design (CAD), automation of engineering calculations, analysis and modeling of physical processes, performing dynamic modeling, verification and optimization of products (CAE), information modeling (BIM), AutoCAD, LIRA CAD, SCAD, etc.



## **FUNDAMENTALS OF STRUCTURAL DYNAMICS**

- Dynamics of deformable systems, impact, free vibrations of rod systems, the occurrence of free vibrations, free vibrations of rod systems as systems with distributed mass, seismic loads and effects, approximate methods for calculating natural vibrations of complex systems, kinematic excitation of vibrations.



## **STABILITY OF STRUCTURES**

- Forms of buckling, buckling, stability of systems with one or more degrees of freedom, static method, energy method, stability of plane bending of beams, stability of flat frames, stability analysis by displacement method.



## **INNOVATIVE COMPOSITE MATERIALS**

- Different types of matrices of materials, reinforcement of composite materials, types of reinforcement, classification of composites by the type of reinforcing filler, by type of matrix, by purpose, depending on the type and location of fibers, isotropic and anisotropic composites, fiberglass composites, methods of production of composites, strength criteria and anisotropic composite materials, the Mises - Hill criterion, the Zakharov - Malmeister criterion, the Goldenblatt - Kopnov criterion, nanotechnology for the production of modern composite materials, carbon nanoparticles: fullerenes, nanotubes, astralenes, concrete modified with nanoparticles.



# HEAD OF THE PROGRAMME

**MARINA IGOREVNA RYNKOVSKAYA**



Ph.D in Technical Science, is responsible for the international affairs of the Construction engineering department, associate professor.

**Thesis on the theme:** “Bending and problems of calculating thin elastic shells in the form of a direct and unfolding helicoid on the distributed load and draft of one of the curved supports.”

## **FIELDS OF SCIENTIFIC INTERESTS:**

shaping shells of complex geometry, analytical methods of calculation, building structures, innovative technologies in the study and teaching of engineering disciplines, modern educational techniques.

The author of scientific articles in peer-reviewed Russian and foreign scientific journals (Higher Attestation Commission, SCOPUS, Web of Science), regularly gives speeches at international conferences on engineering, including plenary and invited reports. Reviewer of the international journals Materials (Q2), Applied Sciences (Q2), Metals (Q2) and proceedings of international conferences. She has completed internships as a visiting researcher at CentraleSupélec (France), Esslingen Hochschule (Germany), Beihang University (China). For 10 years she worked in the construction industry at the design institute of the State Unitary Enterprise MO NIIPROEKT, also as a chief specialist.

The head of the student scientific club “Modeling and calculation of complex geometry shells.” The holder of the diploma of the best young university professor in Moscow among non-pedagogical universities. She continually receives grants from Russian and foreign scientific foundations for conducting research and organizing scientific events, including the Russian Federal Property Fund, the Ministry of Science and Higher Education, DAAD, the Potanin Foundation.