

Документ подписан простой электронной подписью  
Информация о владельце:  
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Должность: Ректор  
Дата подписания: 27.06.2025 11:53:16  
Уникальный программный ключ:  
ca953a0120d891083f939673078ef1a989dae18a

**Federal State Autonomous Educational Institution of Higher Education  
"Peoples' Friendship University of Russia named after Patrice Lumumba"**

**Academy of Engineering**

(name of the main educational unit (MEU) that developed the educational program of higher education)

## **WORKING PROGRAM OF THE DISCIPLINE**

### **THEORETICAL MECHANICS**

(name of discipline/module)

**Recommended for the field of study/specialty:**

### **27.03.04 CONTROL IN TECHNICAL SYSTEMS**

(code and name of the training area/specialty)

**The discipline is mastered within the framework of the implementation of the main professional educational program of higher education (EP HE):**

### **DATA SCIENCE AND SPACE SYSTEMS**

(name (profile/specialization) of the educational institution of higher education)

## 1. THE GOAL OF MASTERING THE DISCIPLINE

The discipline "Theoretical Mechanics" is included in the bachelor's program "Data Science and Space Systems" in the direction 27.03.04 "Control in Technical Systems" and is studied in 3, 4 semesters of the 2nd year. The discipline is implemented by the Department of Mechanics and Control Processes. The discipline consists of 4 sections and 19 topics and is aimed at studying the basics of theoretical mechanics, kinematics of a point and a rigid body, statics, dynamics of a point and a rigid body, analytical mechanics. Particular attention is paid to the analysis of methods for solving typical problems and the analysis of the area of their application in professional activities.

The purpose of mastering the discipline is to increase the level of engineering literacy, the formation of fundamental knowledge and skills in applying methods for solving mechanical problems necessary for professional activity and mastering subsequent disciplines.

## 2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Theoretical Mechanics" is aimed at developing the following competencies (parts of competencies) in students:

*Table 2.1. List of competencies developed in students while mastering the discipline (results of mastering the discipline)*

| Cipher | Competence   | Indicators of Competence Achievement<br>(within the framework of this discipline)   |
|--------|--|---|
| GPC-3  | Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities  | GPC-3.1 Knows the theoretical foundations and principles of mathematical modeling;<br>GPC-3.2 Able to develop and use methods of mathematical modeling, information technologies to solve problems of applied mathematics;<br>GPC-3.3 Possesses practical skills in solving problems of applied mathematics, methods of mathematical modeling, information technologies and the basics of their use in professional activities, skills of professional thinking and an arsenal of methods and approaches necessary for the adequate use of methods of modern mathematics in theoretical and applied problems;   |
| GPC-5  | Capable of solving problems of development of science, engineering and technology in the field of control in technical systems, taking into account legal regulation in the field of intellectual property | GPC-5.1 Knows the theoretical foundations of digital technologies, the basics of modeling objects of professional activity, the basics of data analysis and presentation of information;<br>GPC-5.2 Able to solve problems of professional activity using existing methods of modeling, data analysis, and information presentation;<br>GPC-5.3 Possesses skills in developing algorithms and computer programs suitable for practical application;   |
| PC-4   | Able to formulate, analyze and solve engineering problems in the field of ballistics, motion mechanics and spacecraft motion control based on professional knowledge                                       | PC-4.1 Knows the basic concepts and basic algorithms for solving problems in the field of ballistics, motion mechanics and motion control based on automated and automatic systems;<br>PC-4.2 Able to solve engineering problems of an analytical nature in the field of ballistics, motion mechanics and control of spacecraft motion based on professional knowledge;<br>PC-4.3 Possesses the skills to use mathematical methods for processing information obtained as a result of experimental research, the basic methods of analyzing the mechanics of motion and controlling the motion of spacecraft based on standard methods and software packages; |

## 3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL EDUCATION

Discipline "Theoretical Mechanics" refers to the mandatory part of block 1 "Disciplines (modules)" of the educational program of higher education.

As part of the higher education program, students also master other disciplines and/or practices that contribute to the achievement of the planned results of mastering the discipline "Theoretical Mechanics".

*Table 3.1. List of components of the educational program of higher education that contribute to the achievement of the planned results of mastering the discipline*

| <b>Cipher</b> | <b>Name of competence</b>  | <b>Previous courses/modules, practices*</b>     | <b>Subsequent disciplines/modules, practices*</b>   |
|---------------|--|---|---|
| GPC-3         | Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities  | Mathematical analysis;<br>Algebra and Geometry; | Research work / Scientific research work;<br>Technological Training;<br>Undergraduate Training;<br>Space Flight Mechanics;<br>Numerical Methods;<br>Automatic Control Theory;<br>Equations of mathematical physics;<br>Optimal Control Methods;<br>Analysis of Geoinformation Data; |
| GPC-5         | Capable of solving problems of development of science, engineering and technology in the field of control in technical systems, taking into account legal regulation in the field of intellectual property |   | Research work / Scientific research work;<br>Technological Training;<br>Undergraduate Training;<br>Automatic Control Theory;<br>Analysis of Geoinformation Data;  |
| PC-4          | Able to formulate, analyze and solve engineering problems in the field of ballistics, motion mechanics and spacecraft motion control based on professional knowledge                                       |   | Research work / Scientific research work;<br>Technological Training;<br>Undergraduate Training;<br>Space Flight Mechanics;<br>Optimal Control Methods;  |

\* - filled in in accordance with the competency matrix and the SUP EP HE

\*\* - elective disciplines/practices

#### 4. SCOPE OF THE DISCIPLINE AND TYPES OF STUDY WORK

The total workload of the discipline “Theoretical Mechanics” is “8” credit units.

*Table 4.1. Types of educational work by periods of mastering the educational program of higher education for full-time education.*

| Type of academic work                                      | TOTAL,ac.h.       |            | Semester(s) |            |
|--|-------------------|------------|-------------|------------|
|  |                   |            | 3           | 4          |
| <i>Contact work, academic hours</i>                        | 140               |            | 72          | 68         |
| Lectures (LC)  | 70                |            | 36          | 34         |
| Laboratory work (LW)                                       | 0                 |            | 0           | 0          |
| Practical/seminar classes (SC)                             | 70                |            | 36          | 34         |
| <i>Independent work of students, academic hours</i>        | 94                |            | 81          | 13         |
| <i>Control (exam/test with assessment), academic hours</i> | 54                |            | 27          | 27         |
| <b>General complexity of the discipline</b>                | <b>ac.h.</b>      | <b>288</b> | <b>180</b>  | <b>108</b> |
|  | <b>credit.ed.</b> | <b>8</b>   | <b>5</b>    | <b>3</b>   |

## 5. CONTENT OF THE DISCIPLINE

Table 5.1. Contents of the discipline (module) by types of academic work

| Section number | Name of the discipline section | Section Contents (Topics) |  | Type of academic work* |
|----------------|--------------------------------|---------------------------|--|------------------------|
| Section 1      | Introduction                   | 1.1                       | Theoretical Mechanics in the Structure of Scientific and Technical Knowledge. Application Areas of Theoretical Mechanics Methods   | OK                     |
|                |                                | 1.2                       | Vector theory. Projections and coordinates of vectors. Operations on vectors in coordinate representation. Differentiation of a vector function with respect to a scalar argument. | LC, SC                 |
| Section 2      | Kinematics                     | 2.1                       | Kinematics of a point  | LC, SC                 |
|                |                                | 2.2                       | The simplest motions of a rigid body   | LC, SC                 |
|                |                                | 2.3                       | Plane motion of a rigid body   | LC, SC                 |
|                |                                | 2.4                       | Rotation of a rigid body around a fixed axis   | LC, SC                 |
|                |                                | 2.5                       | General case of rigid body motion  | LC, SC                 |
|                |                                | 2.6                       | Complex point movement   | LC, SC                 |
|                |                                | 2.7                       | Complex motion of a rigid body   | LC, SC                 |
| Section 3      | Statics                        | 3.1                       | Axioms and fundamental principles of statics   | LC, SC                 |
|                |                                | 3.2                       | Equilibrium of bodies  | LC, SC                 |
|                |                                | 3.3                       | Friction   | LC, SC                 |
|                |                                | 3.4                       | Center of gravity  | LC, SC                 |
| Section 4      | Dynamics                       | 4.1                       | Dynamics of a material point   | LC, SC                 |
|                |                                | 4.2                       | Geometry of masses   | LC, SC                 |
|                |                                | 4.3                       | General theorems of dynamics   | LC, SC                 |
|                |                                | 4.4                       | Dynamics of a rigid body   | LC, SC                 |
|                |                                | 4.5                       | D'Alembert's principle. Dynamic reactions of connections   | LC, SC                 |
|                |                                | 4.6                       | Fundamentals of Analytical Mechanics   | LC, SC                 |

\* - filled in only for FULL-TIME education: LC – lectures; LW – laboratory work; SC – practical/seminar classes.

## 6. LOGISTIC AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support of the discipline

| Audience type        | Equipping the auditorium   | Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary) |
|----------------------|--|--|
| Lecture              | An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means for multimedia presentations.  |  |
| Seminar              | An auditorium for conducting seminar-type classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with a set of specialized furniture and technical means for multimedia presentations. |  |
| For independent work | A classroom for independent work of students (can be used for conducting seminars and consultations), equipped with a  |  |

| Audience type | Equipping the auditorium   | Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary) |
|---------------|--|--|
|               | set of specialized furniture and computers with access to the Electronic Information System. |  |

\* - the audience for independent work of students MUST be indicated!

## 7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

### *Main literature:*

1. Course of theoretical mechanics: Textbook for universities. 5th ed., corrected / Drong V. I., Dubinin V. V., Ilyin M. M. [et al.]; ed. Kolesnikov K. S., Dubinin V. V. — M.: Publishing house of Moscow State Technical University. N. E. Bauman, 2017. 5th ed., revised. 580 pp. ISBN 978-5-7038-4568-4

2. Brief course of theoretical mechanics. 20th ed., reprinted / Targ S.M. - M.: Higher School, 2010. - 416 p. ISBN 978-5-06-006193-2

3. Meshchersky, I. V. Problems in Theoretical Mechanics: a tutorial / I. V. Meshchersky; edited by V. A. Palmov, D. R. Merkin. - 52nd ed., reprinted - St. Petersburg: Lan, 2019. - 448 p. - ISBN 978-5-8114-4190-7. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/115729> (accessed: 05/07/2023). — Access mode: for authorized users.

4. Collection of short problems in theoretical mechanics: a tutorial / edited by O. E. Kepe. - 7th ed., reprinted. - St. Petersburg: Lan, 2020. - 368 p. - ISBN 978-5-8114-5266-8. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/138186> (accessed: 05/07/2023). — Access mode: for authorized users.

### *Further reading:*

1. Bat', M. I. Theoretical mechanics in examples and problems: a tutorial / M. I. Bat', G. Yu. Dzhanlidze, A. S. Kelzon. - 12th ed., reprinted. - St. Petersburg: Lan', [b. g.]. - Volume 1: Statics and kinematics - 2013. - 672 p. - ISBN 978-5-8114-1035-4. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/4551> (accessed: 05/07/2023). — Access mode: for authorized users.

2. Bat', M. I. Theoretical mechanics in examples and problems: a tutorial / M. I. Bat', G. Yu. Dzhanlidze, A. S. Kelzon. - 10th ed., reprinted. - St. Petersburg: Lan', [b. g.]. - Volume 2: Dynamics - 2013. - 640 p. - ISBN 978-5-8114-1021-7. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/4552> (accessed: 05/07/2023). — Access mode: for authorized users.

3. Dievsky, V. A. Theoretical Mechanics: a textbook / V. A. Dievsky. - 4th ed., corrected and additional. - St. Petersburg: Lan, 2016. - 336 p. - ISBN 978-5-8114-0606-7. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/71745> (accessed: 05/07/2023). — Access mode: for authorized users.

4. Babicheva, I. V. Theoretical Mechanics. Examples and tasks for independent work: a tutorial / I. V. Babicheva, I. A. Abramova. - St. Petersburg: Lan, 2020. - 208 p. - ISBN 978-5-8114-4317-8. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/138154> (accessed: 05/07/2023). — Access mode: for authorized users.

### *Resources of the information and telecommunications network "Internet":*

1. RUDN University EBS and third-party EBSs to which university students have access on the basis of concluded agreements

- Electronic library system of RUDN - ELS  
RUDN <http://lib.rudn.ru/MegaPro/Web>
- Electronic library system "University library online" <http://www.biblioclub.ru>
- EBS Yurait <http://www.biblio-online.ru>
- Electronic Library System "Student Consultant" [www.studentlibrary.ru](http://www.studentlibrary.ru)
- Electronic library system "Troitsky Bridge"
- EBS "Lan"

## 2. 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/>
- Educational and methodological materials for independent work of students in mastering a discipline/module\*:*

1. Lecture course on the subject "Theoretical Mechanics".

\* - all educational and methodological materials for independent work of students are posted in accordance with the current procedure on the discipline page in TUIS!

**DEVELOPER:**

|                             |                  |                                |
|-----------------------------|------------------|--------------------------------|
| Associate Professor         |                  | Saltykova Olga<br>Alexandrovna |
| <i>Position, Department</i> | <i>Signature</i> | <i>Surname I.O.</i>            |

**HEAD OF THE  
DEPARTMENT:**

|                                   |                  |                          |
|-----------------------------------|------------------|--------------------------|
| Head of Department                |                  | Razumny Yuri Nikolaevich |
| <i>Position of the Department</i> | <i>Signature</i> | <i>Surname I.O.</i>      |

**HEAD OF THE EP HE:**

|                             |                  |                          |
|-----------------------------|------------------|--------------------------|
| Head of Department          |                  | Razumny Yuri Nikolaevich |
| <i>Position, Department</i> | <i>Signature</i> | <i>Surname I.O.</i>      |