Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Institution of Higher Education
“National Research Nuclear University “MEPhI”

INSTITUTE OF NUCLEAR PHYSICS AND ENGINEERING

SCIENTIFIC AND EDUCATIONAL CENTER NEVOD

APPROVED УМС ИЯФИТ

Protocol No. 01/08/24-573.1

dated 30.08.2024

ACADEMIC COURSE OUTLINE

ЯДЕРНАЯ ФИЗИКА (NUCLEAR PHYSICS)

Educational program track (speciality) [1] 14.04.02 Nuclear Physics and Engineering
[2] 14.04.01 Nuclear Power Engineering and Thermophysics

Semester	**Labour input, credits**	**Total course academic, hours**	**Lectures, hrs.**	**Practical sessions, hrs.**	**Laboratory sessions, hrs.**	**In the form of practical studies, hrs.**	**Independent studies, hrs.**	**Independent studies monitoring, hrs.**	**Course progress, Exam/Pass-fail exam/Term**
1	4	144	32	32	0		44	0	Ex
Total	4	144	32	32	0	0	44	0	

ABSTRACT

The course "Nuclear physics" consists of 2 sections: «Main concepts of Nuclear Physics. Basic static properties of atomic nuclei. Nuclear forces. Models of atomic nuclei» and «The interaction of particles and radiation with matter. Nuclear reactions and radioactivity. Nuclear fission and thermonuclear fusion». The course introduces of students to the key concepts in the field of nuclear physics, which include: the basic laws of interaction of various types of corpuscular radiation with matter in order to select a method for its effective detection and evaluation of penetrating ability, patterns of micro-structure at the level of nuclei and particles, methods for studying various characteristics of micro-objects.

1. ACADEMIC COURSE GOALS AND OBJECTIVES

The main objective of the study of the discipline "Nuclear Physics" is to give for the future researcher knowledge of the key concepts in the field of nuclear physics, which include: the basic regularities of interaction of various types of corpuscular radiation with matter in order to select a method for its effective registration and evaluation of penetrating ability, mechanism of a structure of micro-objects at the level of nuclei and particles, methods of research of the different characteristics of micro-objects.

2. PLACE OF THE ACADEMIC COURSE IN THE MAIN HIGHER EDUCATION CURRICULUM

Academic discipline "Nuclear Physics" refers to the general scientific cycle of General education program. This discipline is the basis for learning other subjects of professional cycle. For the successful development of the provisions of this discipline a student should:

- to know: a foreign language at the level necessary to receive professional content from foreign sources; concepts and methods of mathematical analysis: differential calculus, integral calculus and the function of several variables; analytic geometry; linear algebra; vector and tensor analysis; theory of functions of a complex variable; ordinary differential equations; the theory of probability and mathematical statistics; general physics: mechanics, molecular physics, electricity and magnetism, waves and optics; basic concepts of quantum mechanics and atomic physics.
- to be able: to use mathematical methods in physical applications; solve algebraic equations and systems of differential equations, applied to real processes; apply methods of analysis and solutions of problems of calculation of the mechanical characteristics, electromagnetic and nuclear systems;
- to be possess: methods of mathematical analysis; methods of solving problems of analysis and the calculation of the physical characteristics of the systems; main methods of work on the PC, including the methods of working with software applications; mathematical description of microscopic objects within the atomic physics and quantum mechanics; mathematical methods of analysis of phenomena.

This discipline is fundamental for the for further learning of the following disciplines and practices: an experimental nuclear physics, elementary particle physics, experimental methods of high and ultra-high-energy physics, cosmic-ray physics, non-accelerator high-energy physics, the automation of physical experiment, cosmic-ray muon physics and others.

3. DEVELOPED COMPETENCIES AND INTENDED LEARNING OUTCOMES

Universal and/or general professional competencies:

Competency code and title	**Code and title of competency-based rubrics**
ОПК-1 [1] – Capable of formulating research goals and objectives, selecting evaluation criteria, and identifying task priorities	З-ОПК-1 [1] – У-ОПК-1 [1] – В-ОПК-1 [1] –
ОПК-1 [2] – Capable of formulating research goals and objectives, selecting evaluation criteria, and identifying task priorities	З-ОПК-1 [2] – У-ОПК-1 [2] – В-ОПК-1 [2] –
ОПК-2 [2] – Capable of applying modern research methods, evaluating and presenting the results of completed work	З-ОПК-2 [2] – У-ОПК-2 [2] – В-ОПК-2 [2] –
ОПК-2 [1] – Capable of applying modern research methods, evaluating and presenting the results of completed work	З-ОПК-2 [1] – У-ОПК-2 [1] – В-ОПК-2 [1] –
ОПК-3 [1] – Capable of preparing research outputs in the form of articles, presentations, scientific reports, and slide decks using desktop publishing systems and office software suites	З-ОПК-3 [1] – У-ОПК-3 [1] – В-ОПК-3 [1] –
ОПК-3 [2] – Capable of preparing research outputs in the form of articles, presentations, scientific reports, and slide decks using desktop publishing systems and office software suites	З-ОПК-3 [2] – У-ОПК-3 [2] – В-ОПК-3 [2] –

Professional competencies in compliance with the goals and professional knowledge areas:

Professional activity goal	**Professional activity knowledge area**	**Professional competency code and title; Based on the professional standard, experience analysis**	**Code and title of competency-based rubrics**
research			
		ПК-3 [1] - Capable of assessing prospects for development of the nuclear industry and using its modern	З-ПК-3[1] - ; У-ПК-3[1] - ; В-ПК-3[1] -

		achievements and advanced technologies in research activities *The base:* Professional standard: 24.078, 40.008	
		ПК-4 [1] - Capable of independently performing experimental and theoretical research to solve scientific and production tasks *The base:* Professional standard: 24.078, 40.011	З-ПК-4[1] - ; У-ПК-4[1] - ; В-ПК-4[1] -
		ПК-7 [2] - Capable of using and evaluating modern achievements of science and technology to solve professional tasks in research activities *The base:* Professional standard: 24.028	З-ПК-7[2] - ; У-ПК-7[2] - ; В-ПК-7[2] -
		ПК-8 [2] - Capable of possessing computational-theoretical and experimental methods for studying physical processes, performing experimental research, and processing, analyzing, and summarizing obtained results *The base:* Professional standard: 24.028	З-ПК-8[2] - ; У-ПК-8[2] - ; В-ПК-8[2] -
		ПК-5 [1] - Capable of performing calculations and design of physical installations and instruments using modern information technologies	З-ПК-5[1] - ; У-ПК-5[1] - ; В-ПК-5[1] -

		The base: Professional standard: 40.008, 40.011	
		ПК-6 [1] - Capable of assessing risks and determining safety measures for new installations and technologies, developing and analyzing accident scenarios, and reducing risk probability *The base:* Professional standard: 24.078, 40.008	З-ПК-6[1] - ; У-ПК-6[1] - ; В-ПК-6[1] -
		ПК-10 [1] - Capable of solving engineering-physical and economic problems using application software packages *The base:* Professional standard: 24.028, 40.008	З-ПК-10[1] - ; У-ПК-10[1] - ; В-ПК-10[1] -
		ПК-13 [1] - Capable of designing, creating, and implementing new products and systems and applying theoretical knowledge in real engineering practice *The base:* Professional standard: 40.008, 40.011	З-ПК-13[1] - ; У-ПК-13[1] - ; В-ПК-13[1] -

4. ACADEMIC COURSE STRUCTURE AND CONTENT

Academic course sections, their scope, terms of study and assessment:

No.	Academic course section name	Weeks	Lectures/ Practical (seminars)/ Laboratory sessions, hrs.	Compulsory current assessment (form*, week)	Maximum grade per section**	Section assessment (form*, week)	Competency-based rubrics
	1 Semester						
1	Unit	1-8	16/16/0	TstP-8	25	SA-8	З-ОПК-1,

				(25)			У-ОПК-1, В-ОПК-1, З-ОПК-1, У-ОПК-1, В-ОПК-1, З-ОПК-2, У-ОПК-2, В-ОПК-2, З-ОПК-2, У-ОПК-2, В-ОПК-2, З-ОПК-3, У-ОПК-3, В-ОПК-3, З-ОПК-3, У-ОПК-3, В-ОПК-3, З-ПК-3, У-ПК-3, В-ПК-3, З-ПК-4, У-ПК-4, В-ПК-4, З-ПК-5, У-ПК-5, В-ПК-5, З-ПК-6, У-ПК-6, В-ПК-6, З-ПК-7, У-ПК-7, В-ПК-7, З-ПК-8, У-ПК-8, В-ПК-8, З-ПК-10, У-ПК-10, В-ПК-10, З-ПК-13, У-ПК-13, В-ПК-13
2	Unit	9-16	16/16/0	TstP-16 (25)	25	SA-16	З-ОПК-1, У-ОПК-1, В-ОПК-1, З-ОПК-1, У-ОПК-1, В-ОПК-1, З-ОПК-2, У-ОПК-2, В-ОПК-2, З-ОПК-2, У-ОПК-2,

							В-ОПК-2, З-ОПК-3, У-ОПК-3, В-ОПК-3, З-ОПК-3, У-ОПК-3, В-ОПК-3, З-ПК-3, У-ПК-3, В-ПК-3, З-ПК-4, У-ПК-4, В-ПК-4, З-ПК-5, У-ПК-5, В-ПК-5, З-ПК-6, У-ПК-6, В-ПК-6, З-ПК-7, У-ПК-7, В-ПК-7, З-ПК-8, У-ПК-8, В-ПК-8, З-ПК-10, У-ПК-10, В-ПК-10, З-ПК-13, У-ПК-13, В-ПК-13
	Totals for 1 Semester		32/32/0		50		
	Assessment events for 1 Semester				50	Ex	З-ОПК-1, У-ОПК-1, В-ОПК-1, З-ОПК-1, У-ОПК-1, В-ОПК-1, З-ОПК-2, У-ОПК-2, В-ОПК-2, З-ОПК-2, У-ОПК-2, В-ОПК-2, З-ОПК-3, У-ОПК-3, В-ОПК-3, З-ОПК-3, У-ОПК-3, В-ОПК-3, З-ПК-3, У-ПК-3,

							В-ПК-3, З-ПК-4, У-ПК-4, В-ПК-4, З-ПК-5, У-ПК-5, В-ПК-5, З-ПК-6, У-ПК-6, В-ПК-6, З-ПК-7, У-ПК-7, В-ПК-7, З-ПК-8, У-ПК-8, В-ПК-8, З-ПК-10, У-ПК-10, В-ПК-10, З-ПК-13, У-ПК-13, В-ПК-13

* – abbreviated name of assessment

** – 100 maximum points per semester including a pass/fail exam and (or) an exam

Abbreviated current assessment forms and section assessment

Abbreviation	**Full name**
TstP	Test paper
SA	Summative assessment
Ex	Exam

SYLLABUS

Weeks	**Topics / Content**	**Lect., hrs.**	**Pr./sem., hrs.**	**Lab., hrs.**
	1 Semester	32	32	0
1-8	**Unit**	16	16	0
1	**The regularities of quantum mechanics.** The regularities of quantum mechanics. Units of measurement. The scale of the quantities in nuclear physics. Relativistic formulas for free particles.	All		
		0	0	0
		Online		
		0	0	0
2	**Types of interactions in nature.** Types of interactions in nature. The interaction constants. The Standard Model of elementary particles.	All		
		0	0	0
		Online		
		0	0	0
3	**Basic static characteristics of the atomic nuclei.** Basic static characteristics of the atomic nuclei. Measurement units of the masses. Methods for the nucleus mass measuring. Mass number. Isotopes. The binding energy of the nucleus and	All		
		0	0	0
		Online		
		0	0	0

	Semi-empirical mass formula.			
4	**Spin and magnetic moments of the nuclei.** Spin and magnetic moments of the nuclei. Isotopic spin. Electric and magnetic moments of nucleons and nuclei.	All		
		0	0	0
		Online		
		0	0	0
5	**Nuclear forces.** The properties of nuclear forces. Central and tensor forces. Meson theory of nuclear forces. Exchange capacity and saturation. Hadron processes at ultrahigh energies.	All		
		0	0	0
		Online		
		0	0	0
6	**Models of atomic nuclei.** The liquid-drop nuclear model. The formula for the nucleus binding energy calculation. Model applicability.	All		
		0	0	0
		Online		
		0	0	0
7	**Models of atomic nuclei.** The Fermi gas model. Spherical Shell Model. Calculation of spin and parity for the nucleus ground state.	All		
		0	0	0
		Online		
		0	0	0
8	**Models of atomic nuclei.** The generalized model. The rotational levels. Deformed nuclei.	All		
		0	0	0
		Online		
		0	0	0
9-16	**Unit**	16	16	0
9	**Interaction of charged particles with substance.** Interaction of charged particles with substance. Ionization energy loss of charged particles. Delta electrons. Multiple scattering of charged particles. Bremsstrahlung. Bremsstrahlung energy losses. Critical energy and radiation length unit.	All		
		0	0	0
		Online		
		0	0	0
10	**Interaction of charged particles with substance.** Cherenkov radiation and its characteristics. Application for the particle registration. Transition radiation. Cyclotron and synchrotron radiation.	All		
		0	0	0
		Online		
		0	0	0
11	**Interaction of gamma rays with substance.** Photoeffect. Compton effect. Production of electron-positron pairs. Pair production cross-section. Absorption of gamma rays in substance.	All		
		0	0	0
		Online		
		0	0	0
12	**Nuclear reactions.** Conservation laws. Mechanisms and models of nuclear reactions. The compound nucleus model. Interaction of low-energy neutrons with nuclei. The Breit-Wigner formula. Nucleon-nucleon interactions.	All		
		0	0	0
		Online		
		0	0	0
13	**Nuclear reactions.** Direct nuclear reactions. Photonuclear reactions. Internal conversion. Multipole transitions and selection rules for gamma radiation. Resonant interaction of photons with nuclei. Giant resonance.	All		
		0	0	0
		Online		
		0	0	0
14	**Radioactivity.** Nuclear decays. Laws of radioactive decay. Transuranic elements. Alpha decay.	All		
		0	0	0
		Online		
		0	0	0
15	**Radioactivity.**	All		

	Beta decay. Parity violation. Gamma radiation of nuclei. Mossbauer effect.	0	0	0
		Online		
		0	0	0
16	**Nuclear fission.** Spontaneous and induced fission. Mass and the angular distribution of the fragments. Emitted particles. Nuclear-power engineering. Thermonuclear process.	All		
		0	0	0
		Online		
		0	0	0

Abbreviated names of online options:

Abbreviation	**Full name**
EC	E-course
FtM	Full-text material
FtL	Full-text lectures
VM	Video materials
AM	Audio materials
Prs	Presentations
T	Tests
ERM	E-reference materials
IS	Interactive site

5. EDUCATIONAL TECHNOLOGIES

The teaching of the discipline is based on the traditional technology: lectures, practices on each topic and tests for the control of the degree of mastery of the material, random control; exam.

6. ASSESSMENT TOOLKIT

The assessment toolkit ensures verification of the intended learning outcomes achievement (competency-based rubrics) using current, midterm and interim assessment of the course.

The link between developed competencies and their assessment is presented in the following table:

Competency	**Achievement rubrics**	**Assessment activity (Syl 1)**
ОПК-1	З-ОПК-1	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ОПК-1	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ОПК-1	Ex, SA-8, SA-16, к.р-8, к.р-16
ОПК-2	З-ОПК-2	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ОПК-2	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ОПК-2	Ex, SA-8, SA-16, к.р-8, к.р-16
ОПК-3	З-ОПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ОПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ОПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
ПК-10	З-ПК-10	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-10	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-10	Ex, SA-8, SA-16, к.р-8, к.р-16
ПК-13	З-ПК-13	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-13	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-13	Ex, SA-8, SA-16, к.р-8, к.р-16

ПК-3	З-ПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
ПК-4	З-ПК-4	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-4	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-4	Ex, SA-8, SA-16, к.р-8, к.р-16
ПК-5	З-ПК-5	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-5	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-5	Ex, SA-8, SA-16, к.р-8, к.р-16
ПК-6	З-ПК-6	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-6	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-6	Ex, SA-8, SA-16, к.р-8, к.р-16
ОПК-1	З-ОПК-1	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ОПК-1	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ОПК-1	Ex, SA-8, SA-16, к.р-8, к.р-16
ОПК-2	З-ОПК-2	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ОПК-2	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ОПК-2	Ex, SA-8, SA-16, к.р-8, к.р-16
ОПК-3	З-ОПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ОПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ОПК-3	Ex, SA-8, SA-16, к.р-8, к.р-16
ПК-7	З-ПК-7	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-7	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-7	Ex, SA-8, SA-16, к.р-8, к.р-16
ПК-8	З-ПК-8	Ex, SA-8, SA-16, к.р-8, к.р-16
	У-ПК-8	Ex, SA-8, SA-16, к.р-8, к.р-16
	В-ПК-8	Ex, SA-8, SA-16, к.р-8, к.р-16

Educational achievement rubrics scales

The scale of each assessment activity varies from 0 to the maximum established point, inclusive. The final assessment of the course is performed on a 100-point scale and represents the sum of the points earned by the student in the section assessments, framework of current and interim assessment.

Sections and interim assessments are considered passed when the student achieves a minimum score equal to 60% of the maximum. The final grade is assigned only upon passing all sections and the interim assessment.

The final grade is assigned in accordance with the following scale:

<table>
<tr><th>Total score</th><th>Rating on a 4-point scale</th><th>Pass/fail examination</th><th>ECTS assessment</th></tr>
<tr><td>90-100</td><td>5 – «excellent»</td><td rowspan="7">«pass»</td><td>A</td></tr>
<tr><td>85-89</td><td rowspan="2">4 – «good»</td><td>B</td></tr>
<tr><td>75-84</td><td>C</td></tr>
<tr><td>70-74</td><td rowspan="2">D</td></tr>
<tr><td>65-69</td><td rowspan="2">3 – «satisfactory»</td></tr>
<tr><td>60-64</td><td>E</td></tr>
<tr><td>below 60</td><td>2 – «fail»</td><td>«fail»</td><td>F</td></tr>
</table>

An “excellent” grade indicates a deep and solid mastery of the program material by a student who presents their answers consistently, clearly, and logically, is able to closely link theory with practice, and uses materials from monographic literature in their answers.

A “good” grade corresponds to a student’s solid knowledge of the material, who presents their answers competently and to the point, without any significant inaccuracies.

A “satisfactory” grade corresponds to the basic level of mastery of the material by the student, in which the main material has been mastered, but its details have not been assimilated, the answers contain inaccuracies, insufficiently correct wording and logical inconsistencies.

A grade “pass” corresponds to at least a basic level of mastery of the program material, in which the student possesses the necessary knowledge, skills, and abilities, and is able to apply theoretical principles to solve typical practical problems.

A grade “fail” is given to a student who lacks a significant understanding of the curriculum material, makes significant errors in their answers, or fails all required assignments. These students are generally unable to continue their studies without additional classes.

7. ACADEMIC COURSE EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT

CORE READING:

1. ЭИ Я 79 Nuclear English : учебное пособие, Ярыгина Т.Б., Москва: НИЯУ МИФИ, 2024

2. ЭИ Б 42 Атомная и ядерная физика: радиоактивность и ионизирующие излучения : учебник для вузов, Бекман И. Н., Москва: Юрайт, 2025

3. ЭИ С 14 Ядерная физика : учебник для вузов, Сазонов А. Б., Москва: Юрайт, 2025

FURTHER READING:

1. ЭИ T16 Fundamentals of Nuclear Physics : , Takigawa, Noboru. , Washiyama, Kouhei. , Tokyo: Springer Japan, 2017

2. ЭИ P93 Problem book for the course Nuclear Physics : Educational edition, Barbashina N.S. [и др.], Moscow: National Research Nuclear University MEPhI, 2020

3. 53 К17 Основы физики Т.3 Упражнения и задачи, Калашников Н.П., Москва: Лаборатория знаний, 2019

SOFTWARE:

No special softwares is required

LMS AND ONLINE RESOURCES

1. ScienceDirect is a leading full-text scientific database offering journal articles and book chapters (http://www.sciencedirect.com/science/journals/)

2. Nature Publishing Group (NPG) (http://www.nature.com/)

3. Springer. Providing researchers with access to millions of scientific documents from journals, books (http://link.springer.com/)

4. Научная электронная библиотека eLIBRARY.RU. (http://elibrary.ru/)

5. Электронная библиотека НИЯУ МИФИ (www.library.mephi.ru)

https://online.mephi.ru/

http://library.mephi.ru/

8. LOGISTICAL SUPPORT

Any special logistical support is not required

9. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

Due to the large volume of the material being studied and a limited number of classes, a student work on assignments in general must to be independent. It is possible to use any literature and Internet resources. It is encouraged to contact the teacher for advice.

The working program of the discipline "Nuclear Physics" provides independent work of students. Independent work is carried out to improve knowledge on the subject and provides:

- the study of individual sections of the discipline based on the lectures and recommended literature;
- preparation for practical training;
- work with Internet sources;
- training to various forms of control.

By the program of the discipline is providing the solution of exercises in the homework.

The Scheduling time for independent work necessary to study of this discipline, students are best carried out on the whole semester, foreseen at this the regular repetition of the material. The material, which was noted during the lectures, should be regularly be supplemented with information from the literature presented in the work program.

For each self-study topic, presented in the work program of the discipline it should be firstly read the recommended literature and, if necessary, make a brief summary of the main provisions of terms of information, which are necessary to be remember and are fundamental in this subject and for the further exploration of the subsequent sections of the course.

To increase knowledge on the subject it is recommended to use Internet resources: to provide the search in different systems and the use of materials of sites recommended by a teacher at the lectures.

The materials used in the control of students' knowledge:

1. quizzes for homework.
2. checking and defend of homework by students on the 16th week.

3. conducting tests in each section of the course.

10. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR TEACHERS

Цель курса – познакомить с идеями и методами ядерной физики; выработать у студентов навыки научно-исследовательского подхода к решению практических задач по ядерной физике, возникающих в процессе проведения ядерно-физического эксперимента.

Многие из магистрантов закончили региональные университеты, в которых уровень преподавания атомно-ядерной физики в рамках Курса общей физики сильно отличается от стандарта НИЯУ МИФИ. Поэтому необходимо особое внимание уделить вводным разделам, посвященным понятиям квантовой механики и атомной физики. В связи с этим необходимо сделать упор на изложении материала в приложении к задачам классического курса «Ядерной физики». Лекции должны сопровождаться наглядным иллюстративным материалом, в частности, с использованием компьютерных презентаций. Следует уделить особое внимание практическим расчетам, выполняемым самими студентами при работе над текущими заданиями. Допускается использование студентами справочных материалов, необходимых для проведения численных расчетов. Формулировку практических заданий следует выполнять подробно, а так же допускать использование интернет-ресурсов при работе над заданиями.

Контроль работы студента проводить в виде опроса по выполненному домашнему заданию. Все задачи домашнего задания должны быть сданы преподавателю на 16-й неделе.

Author(s):

Dmitrieva Anna Nikolaevna / Дмитриева Анна Николаевна / , к.ф.-м.н.

YAshin Igor Ivanovich / Яшин Игорь Иванович / , д.ф.-м.н., профессор