Federal State Autonomous Educational Institution of Higher Education
"Peoples' Friendship University of Russia»

Engineering Academy

Recommended by the ISSN

THE WORKING PROGRAM OF THE DISCIPLINE

Name of the discipline: Numerical methods for Civil Engineering

Direction / Specialty: 08.04.01 Civil Engineering

**Direction: <u>Civil Engineering and Built Environment ,
Mechanics of materials and engineering structures,</u>**

<u>Built environment of smart city</u>

1. Goals and objectives of the discipline

The purpose of mastering the discipline "Numerical methods for Civil Engineering" is to complete the study of knowledge, skills and experience in the field of design of building structures that characterize the stages of competence formation and ensure the achievement of the planned results of the development of the educational program.

The objectives of the discipline "Numerical methods for Civil Engineering" are to study the theoretical foundations of analytical and numerical methods for calculating structures, analyze methods for calculating building structures, justify and select engineering methods for calculating structures, and develop practical skills for calculating structures using numerical methods using computer technology.

2. Place of the discipline in the structure HP ED:

The discipline "Numerical methods for Civil Engineering" belongs to the variable part of block 1 of the curriculum.

Table 1 shows the previous and subsequent disciplines aimed at the formation of the discipline's competencies in accordance with the matrix of competencies of the Higher Professional Education Department.

Prior and subsequent disciplines aimed at the formation of competencies Table 1

№	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
General competencies			
	GC-1		Mathematical methods of experimental data processing
	GC-3		Geometric Shaping and Analysis of Shells
General professional competencies			
	GPC-1		Fundamentals of the Finite Element Method
Professional competencies (type of professional activity of a civil engineer)			
	PC-1		Structural Stability, Structural Dynamics

3. Requirements for the results of mastering the discipline

The process of studying the discipline is aimed at the formation of the following competencies:
- is able to carry out a critical analysis of problem situations on the basis of a systematic approach, to develop a strategy of actions (GC-1);
- is able to organize and manage the work of the team, developing a team strategy to achieve the goal (GC-3);
- is able to solve problems of professional activity based on the use of theoretical and practical foundations of natural and technical sciences, as well as mathematical apparatus (GPC-1);
- conducting applied research in the field of engineering and technical design for urban planning activities (PC-1).

As a result of studying the discipline, the student must:

To know:
- key concepts and definitions, assumptions and principles used in analytical and numerical methods for calculating structures,
- systems of equations describing the SSS of solid deformable bodies, including plates and shells,
- boundary conditions for various methods of supporting the structure,
- methods for calculating the strength of thin-walled spatial structures for various types of loads,
- methods for calculating the strength of plates and shells.

Be able to:
- analyze systems of differential equations describing the SSS of a solid deformable body,
- determine the possibility of using analytical and numerical calculation methods for various types of structures,
- develop algorithms and programs for calculating SSS of building structures,
- analyze the calculation results.

Own:
- practically methods of calculating building structures to determine their stress-strain state under various types of static load,
- skills of searching for information on methods of calculating building structures of a given type.

4. Scope of the discipline and types of academic work

The total workload of the discipline is 4 credit units.

Type of academic work	Total hours	semester
		4
Classroom sessions (total)	48	48
Including:	-	-
Lectures	16	16
Practical lessons (PL)	32	32
Seminars (S)		
Laboratory work (LW)		
Independent work (total)	96	96
Total labor intensity hour	144	144
Credit units	4	4

5. Content of the discipline
5.1. Content of discipline sections

No	Name of the discipline section	Section content (topics)
1	**Fundamentals of variational methods for calculating structures**	- Solving problems of bending beams by Variational methods. - Fundamentals of the Variational methods. - Lagrange's variational principle. - Direct variational methods for solving problems in the theory of elasticity. - Solution of plate bending problems by Variational methods.
2	**Fundamentals of the Finite element method (FEM)**	- Functions of the shape and stiffness matrix of the final element. - Structural stiffness matrix based on FEM. Calculation of the SSS of the construction. - Calculation of the plate by the Finite element method.

3	**Variational-difference method for calculating structures**	- Introduction to the Variational-difference method for calculating structures. -Example of calculating a plate using the Variational-difference method.

5.2. Sections of disciplines and types of classes

No	Name of the discipline section	Lectures	Practice	Lab. work	Sem.	Independent work of students	Total hour
1.	**Fundamentals of variational methods for calculating structures**	8	18			40	66
2.	**Fundamentals of the finite element method (FEM)**	6	10			36	52
3	**Variational-difference method for calculating structures**	2	4			20	26

6. Laboratory workshop

The discipline "Numerical methods for Civil Engineering" does not provide for conducting laboratory work.

7. Practical exercises (seminars)

Item no.	of the discipline section	Topics of practical classes (seminars)	Laborcapacity (hour.)
1	1	Solution of plate bending problems by variational methods	18
2	2	Calculation of the plate by the finite element method	10
3	3	Calculation of the plate by the variational-difference method	4
	Total:		**32**

8. Materialand technical support of the discipline

Audience with a list of material and technical support	Location
Lecture hall No. 408 Equipment and furniture: - technical means: - projection screen; - Epson EH-TW 3200 multimedia projector; - a set of specialized furniture: tables, benches, chairs, blackboard.	Moscow, Ordzhonikidze str., 3
Training room for seminars, practical classes, current control and intermediate certification No. 418 Equipment and furniture: - training models; - screen;	Moscow, Ordzhonikidze str., 3

- NEC Z projector; - set of specialized furniture: tables, benches, chairs, blackboard.	
Classroom for laboratory work (laboratory) No. 10 "Materials Resistance Laboratory" Equipment and furniture: - universal testing machine: -50 GMS, GMS-20, KM-50, Press PG-100; training model; laboratory beams direct, oblique bend, bending; screen; projector NEC Z - system unit P430.0/i945/2G10/ 160Gb SATA11/256Mb/FDD/KB+M - 1 PC., - monitor LG Flatron –L1942ST-1 PCs., - HP LaserJet 1012 - 1 PCs, measuring devices and tools - chalk Board.	Moscow, Ordzhonikidze str., 3
Educational and methodical office for independent, research work of students and course design No. 417 (Laboratory of engineering equipment of buildings and Structures) - a set of specialized furniture; - chalkboard, marker board; - ASUS computers-5 pcs., ASER monitors-5 pcs.; - Microlab System Subwoofer-1 pc.; - проекторEPSON EB X11 projector	Moscow, Ordzhonikidze str., 3

9.Informational support of the discipline

a) software: the use of specialized software in the study of the discipline is not provided.

b) databases, information and reference systems and search engines:
1. electronic fund of legal and normative-technical documentation
http://docs.cntd.ru/
2. Yandex search engine https://www.yandex.ru/
3. Google search engine https://www.google.ru/
4. SCOPUS abstract database http://www.elsevierscience.ru/products/scopus/
5. Site of the Ministry of Construction and Housing and Communal Services of the Russian Federation http://www.minstroyrf.ru/
6. Electronic library system RUDN - EBS RUDN
http://lib.rudn.ru/MegaPro/Web
7. EBS "University Library Online" http://www.biblioclub.ru
8. EBS Yurayt http://www.biblio-online.ru
9. EBS "Student Consultant" www.studentlibrary.ru
10. EBS "Doe" http://e.lanbook.com/

10. Educational and methodological support of the discipline

a) basic literature:
1.   Pimenov V.G. Numerical methods in 2 parts. 2017, 111 p.
2.   V. N. Ivanov Fundamentals of numerical methods for calculating structures (2007). RUDN. 64 pages.

3.   Turchak L.I., Plotnikov P. V. Fundamentals of numerical methods: a textbook (2002). 304 p.

b) additional literature:
1.   Ivanov V. N. Analytical methods for calculating non-canonical shells. RUDN Publishing House, 2010, 542 p.
2.   Krahotkina E.V. Numerical methods in scientific calculations: (2015). 162 p.

11. Methodological guidelines for students on mastering the discipline (module)

The organization of classes of the discipline "Numerical methods for Civil Engineering" is carried out according to the following types of educational work: lectures, practical classes.

The implementation of the competence-based approach within the framework of the direction of this training provides for a combination of contact work with the teacher and extracurricular independent work of students in the educational process for a more complete formation and development of their professional skills.

Lectures are held in a live audience, including using a multimedia projector in the form of an educational presentation. The main points of the lecture sessions are outlined by students, individual topics (parts of topics and sections) are offered for self-study with the obligatory compilation of a summary (checked by the teacher during the current control).

The purpose of practical classes is for students to gain knowledge and develop practical skills in the field of calculation of building structures and structures. To achieve these goals, both traditional forms of work are used – problem solving, with specialized software for performing calculation and graphic works, etc., and interactive methods – group work, analysis of specific calculation methods, etc.

Group work when analyzing a specific task, develops the ability to analyze and diagnose problems. Using the method of analyzing a specific task, students develop such qualification qualities as the ability to clearly formulate and defend their point of view in a reasoned manner, the ability to discuss, perceive and evaluate information received in verbal form. Practical classes are held in special classrooms equipped with the necessary visual materials.

Independent work involves students working out individual questions of the theoretical course and completing coursework.

Independent work is carried out in an individual format based on the teaching materials of the discipline. The level of mastering the material on independently studied questions of the course is checked during the current control and certification tests (exam and/or credit).) by discipline.

12. Fund of assessment funds for conducting intermediate certification of students in the discipline (module)

To assess the level of mastering the educational material of the discipline "Numerical methods for Civil Engineering" (estimated materials), including a list of competencies, indicating the stages of their formation, description of the indicators and criteria of assessment of competencies at different stages of their formation, the description of the scales of assessment, typical assignments, or other materials needed for the assessment of knowledge, skills and (or) experience activities that characterize the stages of formation of competences in the process of development of educational programs, instructional materials, procedures evaluation of knowledge, skills and (or) experience activities that characterize the stages of formation of competences developed in full and is available to students on the page of discipline on web-site of RUDN.

The program is designed in accordance with the requirements of the ES HE of RUDN University.

Developer:

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