Federal State Autonomous Educational Institution of Higher Education

PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA

RUDN University

Academy of Engineering

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Special chapters of construction theory

course title

Recommended by the Didactic Council for the Education Field of:

13.04.03. POWER ENGINEERING

field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

Mechanical Engineering

higher education programme profile/specialisation title

2024г.

1. The COURSE GOAL

The discipline "Special chapters of construction theory" is included in the master's degree program "Mechanical Engineering" in the direction of 13.04.03 "Energy Engineering" and is studied in the 3rd semester of the 2nd year. The discipline is implemented by the Basic Department of Energy Engineering. The discipline consists of 9 sections and 15 topics and is aimed at studying the theory, design and calculation of internal combustion engines with various kinematic schemes.

The purpose of mastering the discipline is for students to acquire knowledge on the design of internal combustion engines with various kinematic schemes, as well as to acquire skills in calculating the parameters and dimensions of engine parts and assemblies, which ensure reliable operation during the required life;

2. REQUIREMENTS FOR LEARNING OUTCOMES:

The following competences are formed in the study process.

Table 2.1. List of competences that students acquire during the course

Competence code	Competence descriptor	Competence formation indicators
GC-2	Ability to manage a project at all stages of its life cycle	GC-2.1. Formulates a project task based on the problem posed and a way to solve it through the implementation of project management; GC-2.2. Develops the concept of the project within the framework of the designated problem: formulates the purpose, objectives, justifies the relevance, significance, expected results and possible areas of their application; GC-2.3. Plans the necessary resources, including taking into account the possibility of their replacement.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The subject refers to the variable component of (B1) block of the higher educational programme curriculum.

Within the higher education programme students also master other disciplines and internships that contribute to the achievement of the expected learning outcomes as results ofthe subject mastery

Table 3.1. The list of the higher education programme components that contribute to the achievement of the expected learning outcomes as the course results

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
GC-2	Ability to manage a project at all stages of its life cycle.	Fueld heat engine co-generation plant; Modern computer communication services	Undergraduate practice

* - in accordance with the matrix of competencies and the SUP EP VO

4. WORKLOAD OF THE COURSE AND FORMS OF STUDY WORK

General workload of the course 3 *credits, 108 hours.Table 4.1*. Form of study work of EP HE

Type of academic activities	Total academic hours	Semester(s)			
		3			
Contact academic hours	54	54			

Type of academic activities		Total academic hours	Semester(s)				
			3				
including:							
Lectures (LC)		18	18				
Lab works (LW)		18	18				
Seminars (workshops / tutorials) (S)		18	18				
Self-studies academic hours		27	27				
Evaluation and assessment academic hours		27	27				
Course work / project, credits		0	0				
Course workload	academic hours	108	108				
	credits	3	3				

5. CONTENT OF THE COURSE

Table 5.1. Content of the course

The title of the section of the discipline	Content of the section (topic)	Types of educational work*
Section 1 Fundamentals of the design of internal combustion engines..	General principles of machine design. The main provisions and definitions. The main tasks of designers. Consideration of the economic effect in the design: factors, their influence on the functional purpose of machines.	LC, SM, AW
	Features of the design of the internal combustion engine. Market needs. Methodology and methods (succession, inversion, subsequent development of machines) construction.	LC, SM, AW
	Type of internal combustion engine. The main provisions and definitions. Methods of developing the type of internal combustion engine. The time frame of the type. The reasons for creating a new type (creating a new basic model). Tasks solved by marketers and analysts when creating a type.	
Section 2 The direction of improvement of automotive engines.	Engines with adjustable compression ratio. Variable compression ratio. Schemes of converting mechanisms of internal combustion engines with variable compression ratio and working volume.	LC, SM, AW
	Kinematics of the lever mechanism regulating the compression ratio of the engine.	LC, SM, AW
Section 3 Turning off the engine cylinders.	Regulation of engine operating modes by turning off the cylinders. General provisions. The workflow. Constructive schemes.	LC, SM, AW
	Excessive engine operation and the degree of unevenness of the crankshaft when the cylinders are disconnected.	LC, SM, AW
Section 4 The technique of balancing	General provisions. The workflow. Advantages and disadvantages. Geometry of rotary piston engines. The magnitude of the eccentricity. Determination of the actual contour of the working	LC, SM, AW

supercompact engines.	cavity of rotary piston engines.	
Section 5 Rotary piston engines.	General provisions. The workflow. Advantages and disadvantages. Geometry of rotary piston engines. The magnitude of the eccentricity. Determination of the actual contour of the working cavity of rotary piston engines.	LC, SM, AW
	Kinematics of rotary piston engines: the ratio of the angular velocities of the rotor and the eccentric shaft, the maximum value of the acceleration projection on the axis of the sealing plate.	LC, SM, AW
Section 6 Dynamics of rotary piston engines.	Building an indicator chart. The forces acting on the rotor and the neck of the eccentric. The inertia forces of the rotor. Forces acting on the supporting shaft necks.	
	Balancing of rotary piston engines.	
Section 7 Calculation of the crankshaft by the finite element method, taking into account the stiffness of the conjugate elements.	Of course-an elementary calculation of the stress concentration coefficient of the crankshaft when using Ansys. Comparative analysis of calculation results obtained by different methods.	
Section 8 Shock absorption of engine vibrations on the suspension.	Force factors that cause vibrations of piston internal combustion engines on the suspension. The design diagram of the engine oscillating on the suspension. Concepts of axes, center of suspension stiffness and associated vibrations.	
Section 9 The maximum internal contour of the crankcase of the engine.	The contour of the inner surface of the crankcase of a single-row engine.The contour of the inner surface of the crankcase of a V-shaped engine with identical connecting rods.	

* - LC – lecture, LR – laboratory work, SM – seminars; AW – Autonomous work

6. INTERNSHIP EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Technical Support Requirements

A type of aclassroom	Technical Support Requirements	Special equipment, software
For lectures	An auditorium for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multi-media presentations	Technical means: projector Epson EH- TW5300 (LCD, 1080p 1920 x 1080, 2200Lm, 35000:1, 2 x HDMI, MHL, экран Draper Bar-onet NTSC (3:4) 244/96(8) 152*203 MW
For seminars	Auditorium for seminar-type classes, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and technical means of multimedia presentations	Computer class; technical equipment: personal computers, projection screen, multimedia projector, NEC NP-V302XG, Internet access. Software: Microsoft products (OS, office suite, incl. MS Office/Office 365, Teams, Skype),

For autonomous work	Auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the EIOS	Computer class; technical equipment: personal computers, projection screen, multimedia projector, NEC NP-V302XG, Internet access. Software: Microsoft products (OS, office suite, including. MS Office/Office 365, Teams, Skype)

7.RESOURCES RECOMMENDED FOR THE COURSE:

Main literature:

1. Конструирование и расчет коленчатых валов на выносливость: учебное пособие / П.Р. Вальехо Мальдонадо, А.Н. Краснокутский, Н.Д. Чайнов. — Москва : ИНФРА-М, 2024. — 254 с., [4 с.] ил. — (Высшее образование). — DOI 10.12737/1995197.

2. Конструирование и расчет коленчатого вала поршневого двигателя: учебное пособие / П.Р. Вальехо Мальдонадо, А.Н. Краснокутский, Н.Д. Чайнов. — Москва: ИНФРА-М, 2023. — 130 с. : [3] ил. — (Высшее образование: Бакалавриат). — DOI 10.12737/1863129.

3. Кинематика и динамика автомобильных поршневых двигателей: учеб. пособие / П.Р. Вальехо Мальдонадо, Н.Д. Чайнов. — М. :ИНФРА-М, 2020. — 283 с. + Доп. материалы [Электронный ресурс; URL:http://www.znanium.com]. — (Высшее образование: Бакалавриат). — DOI/10.12737/989072.

4. Конструирование и расчет поршневых двигателей: Учебник для студентов вузов./ Н. Д. Чайнов, А. Н. Краснокутский, Л. Л. Мягков; Под ред. Н. Д. Чайнова. – Москва: Издательство МГТУ им. Н. Э. Баумана, 2018. – 536 с.

5. Чайнов Н. Д., Раенко М. И., Рыжов В. А. Прочность теплонапряженных базовых деталей среднеоборотных двигателей внутреннего сгорания. М.: Машиностроение, 2015. 360 с., ил.

6. Двигатели внутреннего сгорания. В 3 кн. Кн 2. Динамика и конструирование: учебник/ В. Н. Луканин, И. В. Алексеев и др.; под.ред. В. Н. Луканина. М.: Высш.шк., 2007. – 400с.

7. Гоц, А. Н. Расчеты на прочность деталей ДВС при напряжениях, переменных во времени: учебное пособие: -М.: ФОРУМ; ИНФРА-М, 2015.-208 с.

8. Кавтарадзе Р.З. Теория поршневых двигателей. – М.: Изд-во МГТУ им. Н.Э. Баумана, 2016.- 589 с.

Additional readings:

1. Оценка выносливости базовых деталей поршневых двигателей: учеб. пособие/ А. Н. Краснокутский, Л. Л. Мягков, Н. Д. чайнов.- М.: Изд-во МГТУ им. Н. Э. Баумана, 2013.- 102 с., ил.

2. Машиностроение. Энциклопедия. Ред совет: К.В. Фролов (пред.) и др. —М38 М.: Машиностроение. Двигатели внутреннего сгорания. Т. IV-14 / Л.В. Грехов, Н.А. Иващенко,В.А. Марков и др.; Под общ. ред. А.А. Александрова и Н.А. Иващенко. 2013. 784 с.

3. Расчет автомобильных и тракторных двигателей: Учеб пособие для вузов./ А. И. Колчин, В. П. Димидов. - 3 изд. перераб. и доп. – М.: Высш. шк., 2008. – 496 с.:ил.

4. Яманин А. И. Динамика поршневых двигателей внутреннего сгорания: учебник для вузов/ Я.А. И.манин, А.В. Жаров, С.О. Барышкинов. – 2-е изд., стер. — Санкт Петербург: Лань, 2021. —592 с.

5. Основы теории и расчета автотракторных двигателей/ Баширов Р. М. – Уфа: БашГАУ, 2010. – 304

6. Двигатели внутреннего сгорания. В 3 кн. Кн 1. Теория рабочих процессов: учебник/ В.Н. Луканин, И.В. Алексеев и др.; под.ред. В.Н. Луканин-2-е изд., перераб. и доп.- М.: Высш.шк., 2010. – 480 с.

7. В.А. Пронин, Д.В. Жигновская, В.А. Цветков, Введение в расчетную платформу Ansys

Workbench: Лабораторные работы. Часть 1 – СПб: Университет ИТМО, 2019. – 46 с.

Electronic library systems:

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:

    - RUDN Electronic Library System (RUDN ELS) http://lib.rudn.ru/MegaPro/Web

    - EL "University Library Online" http://www.biblioclub.ru

    - EL "Yurayt" http://www.biblio-online.ru

    - EL "Student Consultant" www.studentlibrary.ru

    - EL "Lan" http://e.lanbook.com/

    - EL "Trinity Bridge"

2. Databases and search engines:

    - electronic foundation of legal and normative-technical documentation http://docs.cntd.ru/

    - Yandex search engine https:// www .yandex.ru/

    - Google search engine https://www.google.ru/

    - Scopus abstract database http://www.elsevierscience.ru/products/scopus/

The training toolkit and guidelines for a student:

    1. Collection of lectures on the course Special chapters of construction theory

    * The training toolkit and guidelines for the course are placed on the internship page in the university telecommunication training and information system under the set procedure.

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS INTERNSHIP RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course Special chapters of construction theory
results are specified in the Appendix to the internship syllabus.

    * The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPERS:

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