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 the theory of heat engines

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 the theory of heat engines" is included in the master's degree program "Mechanical Engineering" in the direction of 13.04.03 "Energy Engineering" and is studied in the 2nd semester of the 1st year. The discipline is implemented by the Basic Department of Energy Engineering. The discipline consists of 5 sections and 14 topics and is aimed at studying the physical characteristics of the combined internal combustion engines (CICE) work processes, instilling skills in choosing CICE systems in accordance with the required engine characteristics, ways to organize effective processes that ensure the achievement of high power, economic, and environmental performance of engines.

The purpose of mastering the discipline is to form knowledge in the field of organization of work processes of combined internal combustion engines (CICE).

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-1	Ability to carry out a critical analysis of problematic situations based on a systematic approach, develop a strategy for action.	GC-1.1. Analyzes the problematic situation and decomposes it into separate tasks; GC-1.2. Develops a strategy for solving the task; GC-1.3. Forms possible solutions to problems.
GPC-1	Ability to formulate research goals and objectives, identify priorities for solving problems, and select evaluation criteria.	GPC-1.1. Formulates the goals and objectives of the study; GPC-1.2. Defines the sequence of problem solving GPC-1.3. Formulates the criteria for making a decision.

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 of the 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-1	Ability to carry out a critical analysis of problematic situations based on a systematic approach, develop a strategy for action.	Philosophical issues of technical knowledge; Mathematical modeling of thermal processes; Systems of fuel supply for ICE**; *Prospects for the use of alternative fuels in diesel engines**;* Patenting;	Alternative Energy Sources.
GPC-1	Ability to formulate research goals and objectives, identify priorities for solving problems, and select evaluation criteria.	-	Alternative Energy Sources.

* - 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 *4 credits, 144 hours.Table 4.1.* Form of study work of EP HE

Type of academic activities		Total academic hours	Semester(s)				
			2				
Contact academic hours		68	68				
including:							
Lectures (LC)		17	17				
Lab works (LW)		17	17				
Seminars (workshops / tutorials) (S)		34	34				
Self-studies academic hours		49	49				
Evaluation and assessment academic hours		27	27				
Course work / project, credits		0	0				
Course workload	academic hours	144	144				
	credits	4	4				

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 Thermodynamic cycles of piston engines.	Thermodynamic cycles of reciprocating and combined internal combustion engines.	LC, SM, AW
	The Miller Cycle.	LC, SM, AW
	A process with ignition of a homogeneous mixture from compression (HCCI process).	LC, SM, AW
	Stirling Engine.	LC, SM, AW
	Cycles of steam power plants (SPP).	LC, SM, AW
Section 2 Thermodynamic parameters of the working fluid.	Thermophysical properties of the components of the working fluid.	LC, SM, AW
	Features of changing the parameters of the working fluid.	LC, SM, AW
Section 3 Modeling of the CICE workflow.	Thermodynamic models of the indicator process in the internal combustion engine.	LC, SM, AW
	Indicator and effective indicators of the engine.	LC, LR, SM

	Thermal balance.	LC, LR, SM
Section 4 Methods of calculation of heat release in CICE.	The main types of heat dissipation.	LC, SM, AW
	The law of Vibe. An indicator of the nature of combustion.	LC, LR, SM
Section 5 Heat transfer in CICE.	The evolution of the doctrine of heat exchange in the internal combustion engine. The Nusselt formula.	LC, SM, AW
	The Woschni formula.	LC, LR, SM

* - 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. Кавтарадзе Р.З. Теория поршневых двигателей. Учебник для вузов.- М.: Изд-во МГТУ им. Н.Э. Баумана, 2016.-720 с. http://ebooks.bmstu.press/catalog/198/book1502.html
2. Кавтарадзе Р.З. Локальный теплообмен в поршневых двигателях.- 3 изд. перераб. и доп. – М.: Изд-во МГТУ им. Н.Э. Баумана, 2016.-520 с. https://www.studmed.ru/kavtaradze-rz-lokalnyy-teploobmen-v-porshnevyh-dvigatelyah_3824853ec7c.html

Additional readings:

1. Комбинированные двигателей внутреннего сгорания: Учебник для студентов вузов./ Н. Д. Чайнов, Н. А. Иващенко, А. Н. Краснокутский, Л. Л. Мягков; Под ред. Н. Д. Чайнова.- М.: Машиностроение, 2008. – 496 с. https://www.twirpx.com/file/346021/

2. Патрахальцев Н. Н. Повышение экономических и экологических качеств двигателей внутреннего сгорания на основе применения альтернативных топлив [Текст/электронный ресурс] : Учебное пособие / - М. : Изд-во РУДН, 2008. - 267 с. : ил. - (Приоритетный национальный проект "Образование": Комплекс экспортоориентированных инновационных образовательных программ по приоритетным направлениям науки и технологий). - Приложение: CD ROM (Электр.ресурс). - 94.64.
http://lib.rudn.ru/MegaPro2/Web/SearchResult/ToPage/1

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 <u>Special chapters of the theory of heat engines</u>.

* 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 <u>Special chapters of the theory of heat engines</u> 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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position, educational department	signature	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

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