Federal State Autonomous Educational Institution Of higher education
Peoples' Friendship University of Russia named after Patrice Lumumba

Academy of Engineering

PROGRAM
STATE FINAL EXAM

Major: 13.04.03 Power Engineering

Profile / Specialization: Mechanical Engineering

Graduate qualification: Master degree

Moscow,
2024

1. General Provisions

1.1. The responsibility and procedure for the preparation and conduct of state final tests at the RUDN University, as well as the list, sequence, timeframes for passing the documents necessary for the implementation of state final attestation, between the structural divisions, determines the Procedure for the final state attestation of students.

1.2. State final exam for the major "Mechanical Engineering" includes the State final exam and defense of the final qualifying work in the form of the master's final qualifying work (master's thesis).

1.3. The results of any of the types of attestation tests included in the state final attestation are determined by the marks "excellent", "good", "satisfactory", "unsatisfactory".

2. The purpose and objectives of the state final exam

State final attestation (hereinafter - SFA) is carried out by state examination commissions (hereinafter - SEC) in order to determine the conformity of the results of the graduate majoring in the main educational program "Power Engineering".

The main tasks of the SFA are:

- completion of the formation and determination of the student's level of formation of the competencies provided for by the educational standard of the RUDN University in the direction / specialty 13.04.03 Power Engineering (general cultural, general professional and professional - depending on the type / types of professional activity);
- determination of the level of theoretical and practical readiness of a graduate to solve professional problems defined by the educational standard of the RUDN University in accordance with the type / types of professional activity that / which the educational program is focused on;
- making a decision by the State Electoral Commission on awarding a student who has fully mastered the educational program, the qualification "master degree".

3. Forms and place of SFA in the structure of the educational program

State final attestation refers to the basic part of Block 3 of the curriculum.

State final exam for the educational program "Mechanical Engineering" in the direction / specialty 13.04.03 Power Engineering is carried out in the form of defense of the final qualification work (hereinafter - FQW), including preparation for the defense procedure and the defense procedure, as well as preparation and passing of the state exam.

4. The list of the planned results of the development of the educational program

As a result of mastering the educational program "Mechanical Engineering" in the major 13.04.03 Power Engineering, the graduate must have the following general cultural, general professional and professional competencies:

universal competencies (UC):

UC-1 is capable of searching, critical analysis of problematic situations based on a systematic approach, and developing a strategy for action;

UK-2 is able to manage the project at all stages of its life cycle;

UK-3 is able to organize and manage the work of the team, developing a team strategy to achieve the goal;

UK-4 is able to apply modern communication technologies in the state language of the Russian Federation and foreign language(s) for academic and professional interaction;

UC-5 is able to analyze and take into account the diversity of cultures in the process of intercultural interaction;

UC-6 is able to identify and implement the priorities of its own activity and ways to improve it based on self-assessment;

UC-7 is able to search for the necessary sources of information and data, perceive, analyze, memorize and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the obtained information to solve problems; evaluate information, its reliability, build logical conclusions based on incoming information and data.

general professional competencies (GPC)

GPC-1 is able to formulate research goals and objectives, identify priorities for solving problems, and select evaluation criteria;

GPC-2 is able to apply modern research methods, evaluate and present the results of the work performed.

professional competence (PC)**,** corresponding to the type (types) of professional activity to which (which) the master's program is focused:

research activities:

PC-1 is able to analyze, make scientific generalizations and conclusions, put forward new ideas, interpret and present the results of scientific research;

PC-2 is capable of conducting research and development in the field of professional activity.

design and engineering activities:

PC-1 is capable of analyzing, making scientific generalizations and conclusions, moving new ideas, interpreting and presenting the results of scientific research;

PC-2 is capable of conducting research and development in the field of professional activity.

5. Scope of SFA and types of educational work

State final exam is carried out in the form of contact work and in the form of independent work of students (Table 1).

Table 1 - Scope of SFA and types of educational work

Type of educational work		Total, ac. hours	Semester
			4
Preparation and passing of the state exam			
Contact work of a student with the teacher		4	4
Independent work of the student, including passing the exam		104	104
Type of exam test		exam	
Total labor intensity of the qualification test	academic hours	*108*	*108*
	credit units	*3*	*3*
Preparation for the defense procedure and defense of the final qualifying work (FQW)			

Contact work of a student with the teacher		eight	eight
Independent work of the student, including the defense of the FQW		208	208
Type of exam test		public defense	
Total labor intensity of the qualification test	academic hours	*216*	*216*
	credit units	*6*	*6*
The total labor intensity of the SFA	academic hours	**324**	**324**
	credit units	**nine**	**nine**

6. State examination program

The state exam on the Mechanical Engineering educational program in the direction / specialty 13.04.03 Power Engineering is carried out in two stages:

- stage one - computer testing (test part);
- stage two - the main part.

The purpose of the test part of the state exam is to assess the level of theoretical training of a graduate based on the material of disciplines / modules of the educational program. The test item contains 10 questions. The student is given 20 minutes to complete the test task.

The bulk of the state exam is conducted in writing using exam tickets. Each exam ticket contains five questions.

The questions included in the examination card are interdisciplinary in nature and are aimed at determining the level of theoretical and practical preparedness of the graduate to solve professional problems defined by the educational standard of the RUDN University in accordance with the type / types of professional activity that / which the educational program is focused on.

The total number of exam tickets is determined by the number of students admitted to the state exam. The student is given 90 minutes to prepare and defend a written answer to the ticket.

At the state exam by the members of the SEC, the student may be asked additional questions in the field of the graduate's professional activities, provided for by the educational standard.

The list of questions for preparing for the state exam, as well as the criteria for evaluating the results of this stage of the state final exam are given in the fund of evaluation tools of the State Inspection Agency.

7. Requirements for FQWs and the order of their implementation

The final qualifying work is a work performed by the student, demonstrating the level of his preparedness for independent professional activity.

The general requirements for the content, structure and execution of the FQW, as well as the procedure for its defense, are regulated by the relevant local regulatory and administrative acts of the RUDN University and / or the Engineering Academy, which are listed in clause 7 of this Program.

FQW defense can be carried out in a foreign language (in accordance with the current Regulations).

8. Normative and educational-methodological support of the SFA

1. Federal Law "On Education in the Russian Federation" dated December 29, 2012 No. 273-FZ.

2. The procedure for organizing and implementing educational activities for educational programs of higher education - bachelor's programs, specialist programs, master's programs, approved by Order of the Ministry of Education and Science of the Russian Federation of April 5, 2017 No. 301.

3. The procedure for conducting state final exam for educational programs of higher education - bachelor's programs, specialist programs and master's programs, approved by the Order of the Ministry of Education and Science of the Russian Federation of June 29, 2015 No. 636.

4. The procedure for the implementation of educational activities for educational programs of higher education - bachelor's programs, specialist programs and master's programs at the Peoples' Friendship University of Russia, approved by the Rector's Order No. 171 of 12.03.2018.

5. The procedure for the final state exam of students in higher education programs - bachelor's programs, specialist programs and master's programs at the Peoples' Friendship University of Russia (new edition), approved by the Rector's Order No. 790 of 13.10.2016.

6. Rules for the preparation and execution of the final qualification work of a graduate of the Peoples' Friendship University of Russia, approved by the Rector's Order No. 878 dated November 30, 2016.

7. Regulations for conducting state attestation for educational programs of higher education - bachelor's programs, specialist programs and master's programs at RUDN University, approved by the Rector's Order No. 768 dated 14.12.2015.

8. Order of the Rector of 11.02.2015 No. 65 "On the compulsory study of foreign languages and the defense of FQW in foreign languages in the magistracy".

9. Regulations for individual consultations to prepare students for the defense of FQW in a foreign language and implementation of the procedure for oral defense of FQW in a foreign language, approved by the Rector's Order No. 547 of 20.06.2016.

10. Regulations for the use of the "Antiplagiat" system for checking written educational works at RUDN University, approved by the Rector's Order No. 228 dated March 30, 2018.

11. Basic literature indicated in the work programs of disciplines / modules of the educational program (in preparation for the state exam).

Resources of the information and telecommunications network "Internet":

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

- Electronic library system RUDN - EBS RUDN http://lib.rudn.ru/MegaPro/Web
- EBS "University Library Online" http://www.biblioclub.ru
- EBS Yurayt http://www.biblio-online.ru
- EBS "Student Consultant" www.studentlibrary.ru
- EBS "Doe" http://e.lanbook.com/

2. Databases and search engines:

- electronic fund of legal and normative-technical documentationhttp://docs.cntd.ru/
- Yandex search enginehttps://www.yandex.ru/
- Google search enginehttps://www.google.ru/
- SCOPUS abstract databasehttp://www.elsevierscience.ru/products/scopus/

Software:

1. Specialized software for conducting the test part of the state exam and students' independent work:

- Windows 7 SP1
- Mentor
- MS Office 2010
- SolidWorks Education Edition 2012-2013
- Internet access is provided

Methodological materials for independent work of students in the process of preparing FQW for defense:

1. The procedure for the execution and registration of final qualification works for educational programs of higher education, implemented in the Engineering Academy of the RUDN University (approved by the Order of the Director of the Engineering Academy annually or as required).

9. Logistics support of the SFA

To prepare for the state exam and defend the FQW, students use the premises for independent work.

To conduct the test part of the state exam, a classroom is required, equipped with workstations with personal computers (at least 12), equipped with the necessary software and connection to the Internet.

To conduct the main part of the state examination and / or defense of the FQW, a room with a capacity of 12 or more people is needed, in which workplaces are equipped for all members of the State Electoral Commission, with the ability to listen to reports, view public presentations of speakers, keep records and minutes, there are places for listeners wishing to attend the FQW defense procedure. The necessary equipment of the premises includes:

- equipment for public presentations of FQW results, including a multimedia screen, a projector, audio equipment.
- a board for illustrating answers to questions;
- tablets / stands of at least A1 format (if necessary), for placing the graphic part of the FQW on them.

The student can notify the issuing department of his wishes for additional material and technical equipment (if necessary) of the audience assigned to defend the FQW by a written statement no later than a week before the defense procedure.

10. Appraisal Fund

The fund of assessment tools, formed for the state final exam of students in the Mechanical Engineering educational program in the direction / specialty 13.04.03 Power Engineering, includes:

- a list of competencies that students must master as a result of mastering the educational program;

- description of indicators and criteria for assessing competencies, as well as assessment scales;

- typical control tasks or other materials necessary to assess the results of mastering the educational program;

- methodological materials that determine the procedures for assessing the results of mastering the educational program.

10.1 The list of competencies that students must master as a result of mastering the educational program

As a result of mastering the Mechanical Engineering educational program in the direction / specialty 13.04.03 Power Engineering, the graduate must have all the general cultural, general professional and professional competencies listed in clause 3 of this Program.

10.2 Indicators, criteria and scales for assessing competencies in the process of conducting SFA

Based on the results of two stages of the state exam, a total score is given in accordance with the point-rating system adopted by the RUDN University (score / ECTS / RF score).

The grade received by the student at the first stage is formed on the basis of the test result issued by specialized software (maximum 20 points).

At the second stage of the state exam, the score is determined based on the results of checking the student's written answer to the exam ticket and (if necessary) the quality of the student's answers to additional questions from the SEC members.

The scale and criteria for assessing the state exam are presented in Table 2.

Table 2 - Scale and criteria for assessing the state exam (main part)

Grading scale	**50-80 points**	**30-49 points**	**1-29 points**	**0 points**

Criteria	- the content of the examination card material is fully disclosed; - the material is presented correctly, in a certain logical sequence; - terminology is used accurately; - shown the ability to illustrate theoretical provisions with specific examples, to apply them in a new situation; - the answer sounded independently, without leading questions; - demonstrated the ability to creatively apply knowledge of theory to solving professional problems; - demonstrated a high level of competence formation	- questions of the examination material are presented in a systematic and consistent manner; - demonstrated the ability to analyze the material, but not all conclusions are reasoned and evidentiary; - the assimilation of the main literature is demonstrated. - the answer contains one of the following disadvantages: - there are small gaps in the statement that did not distort the content of the answer; - a mistake or more than two shortcomings were made in the coverage of secondary questions, which are easily corrected at the comment of the examiner.	- the content of the material is incomplete or inconsistently disclosed, but a general understanding of the issue is shown and skills are demonstrated that are sufficient for further assimilation of the material; - mastered the main categories on the considered and additional issues; - there were difficulties or mistakes in the definition of concepts, the use of terminology, corrected after several leading questions; - with incomplete knowledge of the theoretical material, insufficient formation of competencies, abilities and skills was revealed, the student cannot apply the theory in a new situation; - the assimilation of the main literature is demonstrated.	- the main content of the educational material has not been disclosed; - found ignorance or misunderstanding of the most or the most important part of the educational material; - mistakes were made in the definition of concepts, when using terminology, which were not corrected after several leading questions. - competencies, skills and abilities are not formed.

FQW and its defense are assessed in accordance with the point-rating system adopted by the RUDN University (score / ECTS / assessment of the Russian Federation, maximum 100 points) according to the following indicators, which make it possible to assess the level of formation of competencies provided for by the educational program:

Indicators for assessing the defense of FQW	**Maximum score**
- correspondence of the content of the FQW to the approved topic and the issued assignment, clarity of the formulation of the goals and objectives of the study	20
- reliability, originality and novelty of the results obtained in the FQW	10
- the practical value of the completed FQW	10
- style of presentation of the FQW	5
- compliance with the approved requirements for the design of FQW	10
- the quality of the presentation and report during the defense of the FQW	10
- the quality of answers to questions during the defense of FQW	10
- assessment of the FQW by the head (review)	10
- assessment of FQW by a reviewer (review)	10
- availability of publications on the topic of work, certificates, awards, etc.	5

The scale and criteria for assessing the defense of FQWs are presented in Table 3.

Table 3 - Scale and criteria for assessing the defense of FQW

Compliance of the content of the FQW with the approved topic, clarity of the formulation of the goals and objectives of the study				
Scale	**15-20 points**	**5-14 points**	**1-4 points**	**0 points**

Criteria	The FQW was carried out on a topical topic, the goals and objectives of the study were clearly formulated.	The FQW was carried out on a topical topic, there are minor comments on the formulation of the goals and objectives of the study.	Relevance of the topic of the FQW is questionable. The goals and objectives of the FQW are formulated with significant comments, not clearly enough. There is no link between the essence of the topic and the most significant directions for solving the problem under consideration.	The goals and objectives of the FQW do not correspond to the approved topic of work and do not disclose the essence of the research being conducted
Reliability, originality and novelty of the results obtained in the SRS				
Scale	**7-10 points**	**4-6 points**	**1-3 points**	**0 points**
Criteria	An in-depth analysis of the research object has been carried out. The reliability, originality and novelty of the conclusions on the research topic are noted.	Analysis of the object of research is not carried out deeply enough. The reliability, originality and novelty of the conclusions have a number of minor remarks.	The reliability, originality and novelty of the conclusions based on the results obtained cause serious remarks.	The reliability of the results is questioned, the originality and novelty of the results is absent
Practical value of the completed FQW				
Scale	**7-10 points**	**4-6 points**	**1-3 points**	**0 points**
Criteria	The paper provides a new solution to a theoretical or practical problem that is essential for the professional field.	The work provides a partial solution to a theoretical or practical problem that is important for the professional field.	The work considers only the directions of solving the problem, the results obtained are of a general nature or insufficiently reasoned.	Results are notare of practical value
FQW presentation style				
Scale	**4-5 points**	**2-3 points**	**1 point**	**0 points**
Criteria	It is notedscientific style of presentation of the results of work with correct references to literary sources	There are minor remarks on the scientific nature of the presentation of the results and / or on the correctness of references to sources	There are serious remarks about the scientific style of presenting the results of the work and / or about the correctness of references to sources	Stylepresentation does not correspond to scientific, references to sources are incorrect
Compliance with the approved requirements for the execution of FQWs				
Scale	**7-10 points**	**4-6 points**	**1-3 points**	**0 points**
Criteria	FQW fully meets the requirements for registration	FQW with minor remarks meets the design requirements	The FQW has significant comments on compliance with the design requirements	FQW does not meet the requirements for registration
The quality of the presentation and report during the defense of the FQW				
Scale	**7-10 points**	**4-6 points**	**1-3 points**	**0 points**
Criteria	Presentation and the report fully reflect the content of the FQW, demonstrated a good command of the material of the work, confident, consistent and logical presentation of the research results	There are minor comments on the presentation and / or report on the topic of the FQW. Minor inaccuracies were made in the presentation of the results of the FQW, which did not distort the main content of the work.	There are significant comments on the quality of the presentation and / or report on the topic of the FQW. Significant inaccuracies were made in the presentation of the material, affecting the essence of understanding the main content of the SRS, the consistency of the presentation was violated.	Presentation and / or the report does not reflect the essence of the graduation work. No demonstrated proficiency in the material of the work.
The quality of answers to questions during the defense of FQW				
Scale	**7-10 points**	**4-6 points**	**1-3 points**	**0 points**

Crite-ria	Answers toquestions are given in full	Answersnot given com-pletely and / or with slight errors	Answers tothe questions are in-complete, with serious errors	Answers tono questions given
Evaluation of the FQW by the head				
Scale	**7-10 points**	**4-6 points**	**1-3 points**	**0 points**
Criteria	Fine	Good	Satisfactorily	Unsatisfactory
Assessment of FQW by a reviewer				
Scale	**7-10 points**	**4-6 points**	**1-3 points**	**0 points**
Criteria	Fine	Good	Satisfactorily	Unsatisfactory
Availability of publications on the topic of work, certificates, awards, etc.				
Scale	**4-5 points**	**2-3 points**	**1 point**	**0 points**
Criteria	The results of studies have been tested in speeches at conferences, seminars, there are publi-cations in print, the re-sults are confirmed by a certificate of implementa-tion, etc.	The results of research are announced for a report at conferences, seminars, or accepted for publication in print, for implementa-tion.	The results of studies are pre-pared for discussion at confer-ences, seminars, or are being prepared for publication in print, for implementation.	The results of re-search are not planned for publi-cation, report at conferences, semi-nars, for implemen-tation

10.3 Typical control tasks or other materials necessary to assess the results of mastering the educational program

List of questions to prepare for the test stage of the state exam:

1.The essence of the unified series method is

1. preserving the diameter of the cylinders and changing their number;
2. increasing the diameter of the cylinders and maintaining their number;
3. preservation of the number of valves and the length of the connecting rod;
4. preservation of the number of compression rings and the diameter of the connecting rod bolts.

2.To improve fuel efficiency in automotive engines when operating at partial loads,

1.variable compression ratio, shutdown of cylinders and cycles;
2.decrease in coolant temperature, more viscous oil;
3. turning on the fan, turning on the generator;
4. increase in the mass of parts of the crank and cylinder-piston mechanisms.

3. Choose the necessary and sufficient signs of the combined combustion engine.
1. A combination in one power plant of a piston machine, vane machines, heat exchangers.
2. Integration in one power unit of a piston engine, a gas turbine, a compressor and a refrigerator.
3. A combination of a piston engine, blades and heat exchangers, thermodynamically performing a cycle with a single working fluid.
4. Combination of piston internal combustion engine, gas turbine, compressor, expansion machine and heat exchangers in one machine.

4.What is the increased gas turbine boost used for?
1. To reduce the toxicity of emissions.
2. To increase the power of the internal combustion engine.

3. To improve efficiency.
4. To improve the dynamic qualities of the internal combustion engine.

5.What is "mechanical" supercharging?
1. Supercharging with a mechanical compressor drive from a gas turbine.
2. Supercharging with a mechanical compressor drive from the crankshaft.
3. Supercharging with a compressor drive from an external energy source.
4. Supercharging with mechanical connection of the turbocharger with the engine shaft.

6.What is a turbocharger?
1. Pressurization unit driven by a hydraulic turbine.
2. The pressurization unit driven by a gas turbine running on the exhaust gases of the internal combustion engine.
3. A supercharging unit with a compressor drive from an air turbine.
4. Starting unit of a gas turbine.

7.What is isobaric boost?
1. Supercharging the diesel engine with additional air supply to the cylinder in order to maintain a constant intake pressure.
2. Supercharging the internal combustion engine from a gas turbocharger with constant gas pressure in the exhaust pipeline.
3. Supercharging with variable gas pressure, but constant air pressure at the inlet to the cylinders.
4. Supercharging with constant inlet pressure.

8.Rated toxic constituents of exhaust gases of internal combustion engines (compliance with EURO standards):

1.CO, CH, soot (exhaust gas smoke), particulate matter (PM), NOx;
2. CO, CO2, soot (exhaust gas smoke), particulate matter (PM), NOx;
3. CO, CH, Soot (exhaust gas smoke);
4. CO, CH, soot (exhaust gas smoke), particulate matter (PM), NOx, SOx.

9. What is the main advantage of biodiesel fuel?

1. Proximity to diesel fuel in terms of physical and chemical properties.
2.High calorific value.
3.Good frost resistance.
4. Production from renewable resources.

10. What are the working bodies for internal combustion engines made of?

1.From air and fuel vapors.
2.From air, fuel vapors, exhaust gases and water vapor.
3.From air, fuel vapors, residual gases.
4.Oxygen and hydrocarbons.

11.In the bifunctional converter of the exhaust gases of the internal combustion engine, the following processes take place:

1.oxidation and recovery of harmful substances;
2. oxidation and accumulation of harmful substances;
3. filtration and accumulation of harmful substances;

4.decomposition and filtration of harmful substances.

12.Choose the regulated harmful substances in the exhaust gases of the internal combustion engine.

1. Lead oxides.
2. Carbon monoxide, nitrogen oxides.
3.Carbon dioxide.
4. Iron oxides.

13 13-step cycle is used for toxicity testing
1. Internal combustion engine as part of a vehicle;
2. the vehicle as a whole;
3. Internal combustion engine in a motor stand;
4.Only cars with running drums.

14. Soot is contained in the exhaust gases of diesel engines due to
1.the absence of forced ignition of fuel in a diesel engine;
2.the presence of re-enriched with fuel zones near combustion centers;
3. general oxygen deficiency in the combustion chamber of a diesel engine;
4. application of heavier grades of motor fuel in diesel engines.

15. The main condition for the formation of nitrogen oxide in the internal combustion engine is

1. combination of high temperature with the presence of free oxygen;
2. the presence of nitrogen-containing compounds in the fuel;
3.combustion of a homogeneous fuel-air mixture;
4. Combustion of premixed fuel and oxidizer.

16. Why is the exhaust pipe of the engine divided into several pipelines when upgrading an engine with a supercharged engine?
1.To facilitate the installation of the turbocharger.
2.To improve engine maintenance.
3.To save the energy of the exhaust gases and increase the power of the gas turbine.
4.To facilitate engine cooling.

17. List the advantages of using an internal combustion engine pressurization.
1.Increase in the engine's aggregate power with practically unchanged dimensions.
2. Improving efficiency.
3. Possibility of increasing the shaft rotation frequency and, consequently, reducing the installation dimensions.
4. Expansion of the range of possible high-speed modes of engine operation.

18. By what characteristic is the necessary law of change in the composition of the mixture established?
Gasoline ICE?

1. By regulatory.
2. By high-speed.
3.According to the load.
4. By adjusting.

19. What is a turbo compound engine?

1. This is a combined internal combustion engine with a power gas turbine, in which the useful power is removed only from the gas turbine shaft, but not removed from the crankshaft.
2. This is a combined power plant, in which the crankshaft and the turbine shaft are connected with a common transmission to the consumer.
3. This is a combined engine, in which the increased energy of the exhaust gases is transmitted to the blades of the power gas turbine, and the useful power for the consumer is removed both from the diesel shaft and from the turbine shaft.
4. These are two combined internal combustion engines connected by a single transmission with a common energy consumer.

20. The trend in the development of methods for the study of internal combustion engines for toxicity is
1. taking into account transient operating modes of the internal combustion engine.
2.increase in the amount of standardized harmful substances.
3. the transition to tests in the conditions of real movement of the car around the city.
4. Significantly simplifying the test procedure.

21. For the exam of internal combustion engines for toxicity use

1. the norms of the maximum permissible concentration of harmful substances in the air;
2. norms for maximum mass emissions of internal combustion engines of harmful substances;
3. Norms for maximum specific emissions of ICE harmful substances;
4. Standards for the maximum permissible concentration of harmful substances in the exhaust gases of the internal combustion engine.

22. Which of the parameters of the given equation

$$N_e = K \cdot \frac{H_u}{l_o} \cdot \frac{V_h}{30\tau} \cdot i \cdot \frac{\eta_i}{\alpha} \cdot \eta_v \cdot \eta_м \cdot \rho_к \cdot n$$

provide boosting of the engine in terms of supercharged power?
Here:
Ne - effective engine power,
K is a constant,
Hu is the lowest heat of combustion of fuel,
Vh - the working volume of the cylinder,
I - number of cylinders,
lo - stoichiometric number,
τ - stroke (2 or 4),
α - coefficient of excess air,
$\rho_к$ is the density of the charge air,
ηi, ηm, ηv - efficiency indicator, mechanical and filling factor.

1. $\frac{\eta_i}{\alpha}$ and n.
2.Hu and ηv.
3.ρk and n.
4.ρ.

23. What type of CR injectors is used in a diesel engine?

1. Pump-nozzles.

2. Electro-hydraulic nozzles.
3.Double-spring.
4. Electro-hydraulic pin.

24. What is the ratio of the heat of combustion of a unit mass of hydrogen and the same unit of mass of carbon?

1.About 1.
2.About 2.
3.About 3...
4. Equal to 0.5.

25. In how many chambers is the entire working cycle of a rotary piston engine carried out?

1.In one chamber.
2.In two chambers.
3.In three chambers.
4.In four chambers.

26. Choose two groups of primary energy resources.

1.Traditional and non-traditional.
2. Renewable and non-renewable.
3.Liquid and gas.
4.Flammable and non-flammable.

27. What is the stoichiometric amount of air?

1. This is the amount of air that contains 21% oxygen by volume.
2. This is the amount of air in which 1 kg of fuel can be burned.
3This is the amount of air that is theoretically necessary and sufficient for the complete combustion of 1 kg of fuel.
4. This is the amount of air in which the mass fraction of oxygen is 23%.

28. The engine piston power characterizes

1. the quality of the workflow.
2.Economic efficiency of the engine.
3. thermal and dynamic tension of the engine.
4. the efficiency of using the working volume of the engine.

29. Choose the main component of natural gas.

1.ethane (C2H6).
2.propane (C3H8).
3.methane (CH4).
4.butane (C4H10).

30. The start of diesel locomotives, marine diesel engines of medium and high power is carried out

1.electric starter.

2. starting engine.
3.starting handle.
4. compressed air.

31. What indicator characterizes dynamic stresses in engine parts?

1. Average effective pressure.
2.Liter power.
3. Average piston speed.
4. Degree of compression.

32. What is two-stage supercharging?

1. Supercharging by means of two compressors installed in series.
2. Supercharging by means of a series-installed free gas turbine, an air cooler and a drive compressor.
3. Supercharging by means of a gas turbine pump, in which the compressor is made in the form of two successive stages.
4. Supercharging by means of two free turbochargers, in which a high-pressure turbine and a low-pressure compressor sit on one shaft, and a low-pressure turbine and a high-pressure compressor on the other.

33. For the solution of what main tasks are the supercharging control systems (supercharging control) being developed?

1.To reduce mechanical and thermal stresses in parts, eliminate knocking, improve engine speed characteristics, reduce noise and vibration during operation.
2.Improving the environmental characteristics of the engine, compensating for the loss of power and efficiency when climbing to a height, the possibility of using cheap low-octane fuels.
3. To reduce mechanical and thermal stresses in parts, eliminate detonation, the possibility of using alternative fuels.
4. To reduce mechanical and thermal stresses in parts, eliminate knocking, improve engine speed characteristics, improve engine environmental performance, compensate for power loss and economy when climbing to a height.

34. Stirling engine and steam turbine refer to engines with:

1.Internal combustion.
2.External combustion.
3.Two-stage combustion.
4.Knock Combustion.

35.The specificity of automobile engines is that

1. They operate at variable speed and load modes.
2. They work for a long time with a load close to the nominal mode.
3. They work for a long time on all loads at a constant speed mode.
4. They operate at a variable speed mode in the range from nominal to 1/3 - ¼ nominal and at the minimum number of revolutions of the crankshaft.

36.The specificity of generator motors is that

1. They operate at variable speed and load modes.
2. They work for a long time with a load close to the nominal mode.
3. They work for a long time on all loads at a constant speed mode.
4. They operate at a variable speed mode in the range from nominal to 1/3 - ¼ nominal and at the minimum number of revolutions of the crankshaft.

37.What should be done with the opening and closing advance angles of the intake and exhaust valves of a diesel engine when forcing it with supercharging?

1.It is necessary to reduce the advance of the opening of the intake organs and to increase the delay in closing the exhaust.
2. It is necessary to strive to maintain the lead and lag angles of opening and closing valves.
3. It is necessary to increase the advance of the opening of the intake organs and the lag of the closing of the exhaust.
4. It is necessary to increase the advance of the opening of the intake and exhaust organs and to increase the angle of the lag of the closing of the intake and exhaust organs.

38. Why does the use of power gas turbine supercharging improve the mechanical efficiency of the engine, compared to forced supercharging?
1. Because the gas turbocharger is not connected to the engine shaft, but only has a "gas" connection.
2.Because the temperatures of parts and the temperature of the lubricating oil increase, and as a result, mechanical friction losses are reduced.
3.Because with a properly designed engine, pumping losses in the piston part of the engine are reduced.
4.Because the turbocharger creates lower exhaust losses when the exhaust bodies are opened earlier.

39. What is the relevance of using dual fuel supply systems?

1.In the increased reliability of the system.
2.In the possibility of rational regulation of fuel components...
3.In the ability to work on one of the fuels and the absence of the other.
4. In the possibility of repairing fuel equipment without stopping the engine.

40. How does the volumetric flow rate of air supplied by a reciprocating compressor change at a constant rotational speed of its shaft and with an increase in the degree of pressure increase (p2 / p1)?

1. Increases in proportion to the degree of pressure increase.
2. Decreases.
3. Increases in proportion to the compressor displacement.
4. Remains unchanged.

41. What type of compressor is advisable to use when organizing gas turbine supercharging of a diesel engine?

1.Volume, rotary.
2.Piston.
3.Centrifugal.
4.Volume vane.

42.What work must be done on a diesel engine when it is modified into a supercharged one in order to reduce the toxicity and smokiness of the exhaust gas?

1.Fit the turbocharger without changing the intake and exhaust manifolds.
2. Change the intake and exhaust manifolds, install a turbocharger and improve the performance of the fuel equipment.
3. Change the gas exchange phases and reduce the fuel injection advance angle.
4. Change the intake and exhaust manifolds, install a turbocharger, change the gas exchange phases and reduce the fuel injection advance angle.

43. What is pulse boost?

1. Supercharging at variable (pulse) charge air pressure, but constant exhaust gas pressure in front of the gas turbine.
2. Supercharging at variable (pulse) exhaust gas pressure in front of the gas turbine.
3. Supercharging at variable (pulse) charge air pressure.
4. Supercharging using pulse converters in the exhaust system.
44. Thermodynamic cycle with heat supply at V = const (Fig. 1) is characterized by the operation of the cycle Ltv. And a cycle with a mixed heat supply - work Lt, moreover, Ltv = Lt. How do the amounts of supplied heat Q1v (in an isochoric cycle) and Q1 = Q1 '+ Q1 ”(in a cycle with mixed heat supply) compare?

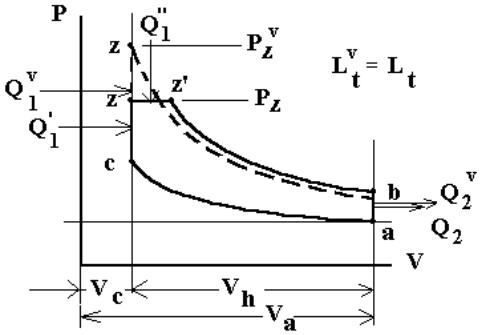

Fig. 1 Comparison of thermodynamic cycles with heat supply at V = const and with mixed heat supply.

1.Q1v = Q1.
2 .Q1v <Q1.
3.Q1v> Q1.
4.Q1v ≥ Q1.

45. For which engine is the cycle shown in Fig. 1 typical?

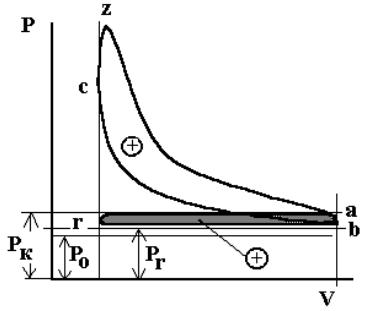

Fig. 1.
1.For a diesel engine, since it does not have increased outlet resistance due to the absence of a gas turbine for the compressor drive.

2.For a diesel engine with supercharging, in which, due to the correct setting of the system, the ratio pk> pr is achieved.
3.For a supercharged diesel engine with an exhaust gas recirculation system.
4.For a spark ignition gas turbine engine.

46. Why is a charge air cooler or intercooler installed in the diesel intake stroke?

1.To reduce the thermal stress of the engine.
2.To increase the motor life of the valves due to their better cooling.
3.To reduce the toxicity and smoke of exhaust gases.
4.To increase the mass filling of cylinders with fresh charge and reduce nitrogen oxides.

47. Why are air heaters installed in the intake stroke of a turbocharged diesel engine?

1.To reduce temperature differences on the blades of the boost compressor in order to reduce the heat stress of the engine.
2. To reduce the fuel ignition delay period and reduce the hardness of the diesel engine.
3. To facilitate starting at low ambient temperatures.
4. To reduce the toxicity and smoke of exhaust gases.

48. How many turbochargers implementing the principle of impulse supercharging is it advisable to install on a 6-cylinder diesel engine in an ideal variant from the point of view of ensuring effective supercharging?

1.Two.
2.Three.
3.One.
4. Six.

49. How is it necessary to change the density of the charge air (ρk) of a diesel engine in order to double the engine power, provided that the quality of the workflow remains unchanged?

1.Reduce by half.
2. Increase by half.
3. Increase more than twice, taking into account the loss of charge density due to the increased air temperature after the compressor.
4. Increase more than two times, taking into account the additional air consumption for purging the cylinders.

50. Why the degree of boost, the value of the charge air pressure in diesel engines can be significantly higher than in engines with forced ignition and external mixture formation?

1.Because diesel has higher safety margins.
2.Because the diesel does not have problems with detonation.
3.Because of a diesel engine, when supercharged, it is possible to significantly enrich the combustible mixture.
4. Because the energy of the exhaust gases in a diesel engine is significantly higher than that of an engine with spark ignition and external mixture formation.

51. What is a Comprex supercharging system?

1.Gasdynamic pressurization system based on the optimal gasdynamic tuning of the intake system.

2. The pressurization system, which uses the inertia of the incoming oncoming air flow.
3. A boost system that uses pressure waves in the exhaust stroke to generate boost pressure in the intake manifold.
4. Pressurization system with a shaft-driven positive displacement compressor.

52. What is differential boost?

1.System with a drive compressor connected to the crankshaft through a differential gear.
2. A system in which the engine through a differential gearbox is connected both to the power take-off shaft and to a drive compressor, preferably a positive displacement blower.
3. A supercharging system, in which the pressure from the drive compressor is differentiated in accordance with the load and the speed of the diesel engine.
4. Supercharging by means of two free turbochargers, in which a high-pressure turbine and a low-pressure compressor sit on one shaft, and a low-pressure turbine and a high-pressure compressor on the other.

53. Which of the ratios is valid for determining the steady-state mode (SD) of a supercharged diesel engine?

1.Me = Mc = var, (n = const).
2.Me = Mc = const, (n = const).
3.Me = f (n, hp, pk, Tk).
4.Ne = f (n, hp, pk, Tk).
Here n, hp, pk, Tk, t are, respectively, the speed, position of the injection pump rail, boost pressure, charge air temperature, and time.

54. What is the ratio of the moments of inertia of the engine (Id), the coupling (Ic) and the installation (Iset) is valid for the autotractor installation?

1. (Id + Ic) = (0.7 + 0.9) Iset.
2. (Id + Ic) = (0.5 + 0.7) Iset.
3. (Id + Ic) = (0.3 + 0.5) Iset.
4. (Id + Ic) = (0.05 + 0.25) Iset.

55. Which of the fuel delivery cycles in Fig. 1 is “active” and which is “passive”?

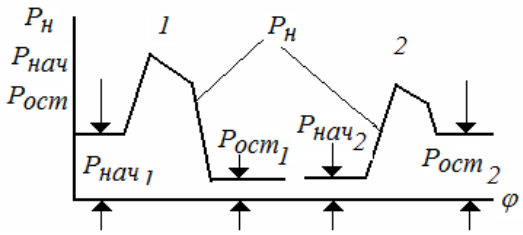

Fig. 1. Diagrams of characteristics of changes in fuel pressure during injection.

1.Respectively, 2 and 1.
2.Respectively, 1 and 2.
3. Cycle 1 in both cases.
4. Cycle 2 in both cases.

56. What is the sustainability factor? Choose the right ratio.

1.Fg = Memax / Menom.

2.Fg = (∂Mc - ∂Me) / ∂n.
3.Fg = (ΔMe. - ΔMc) / Δω.
4.Fg = ∂Me. / ∂n - ∂Mc / ∂n.

57. Which of the listed engines has the greatest efficiency when working on VSH (with equal shares of speed modes), if they have the same rated power and rated speed?

1.Diesel engine
2.Diesel with mechanical supercharging.
3.Diesel with impulse turbocharging system.
4. Diesel with the Hyperbar system.

58. What pressurization system is more acceptable for the modernization of a transport diesel engine from the point of view of the increased dynamic qualities of the car? Arrange systems in order from most preferred to least preferred if
system "a" is a mechanical turbo system,
system "b" is a variable turbocharging system,
the "b" system is a free turbocharging system.
In this case, the degrees of boost are approximately the same. The rated powers achieved by the supercharging are the same.

1. B, c, a.
2. B, a, c.
3. A, b, c.
4. A, c, b.

59. Choose the correct ratio between the initial and residual pressures in the HPL at NUR, if i and i-1 are numbers, respectively, of the current and preceding cycles.

1.Rat.i. cord. = Growth. i-1.cord.
2.Rat.i. cord. = Growth. level i-1.
3.Rat.i. cord. = Growth. i-1.cord. + δ Growth.
4.Rat.i. cord. = Growth. level i-1. + δ Growth.

60. What is the initial pressure (Pinit.) Of fuel in the diesel fuel system?

1.Rat. Is the pressure at which the nozzle needle begins to rise.
2.Rat. Is the pressure at which the high pressure fuel pump discharge valve starts to rise.
3.Rat. Is the pressure at which the fuel is in the HPP of the fuel system between the injection valve of the injection pump and the nozzle shut-off cone before the start of the next fuel supply cycle.
4.Rat. Is the pressure at which the fuel supply process begins.

61. What is the residual pressure (Growth) of fuel in the diesel fuel system?

1. Growth. Is the fuel pressure at which the injection process ends with the injector.
2. Growth. - This is the fuel pressure at which the process of pumping fuel by the high-pressure pump ends.
3. Growth. - this is the fuel pressure at which vacuum appears in the HPP.
4. Growth. Is the fuel pressure that takes place in the HPP after it is unloaded by the unloading belt of the injection valve of the injection pump and the nozzle needle lands on the seat.

62. What explains the increased rigidity of processes in unsteady-modes?

1. Excessive fuel injection.
2. An excessively low thermal state of the engine and a long ignition delay.
3. Decreased thermal state, resulting in increased ignition delay and combustion start offset too close to TDC (but before TDC).
4. Lack of air and, consequently, a lowered charge temperature in the cylinder at the time of fuel injection.

63. What is the cycle controllability factor (ψ) at unsteady-modes?

1.ψnur = φinur / φiur.
2. ψ cord = φin cord / φ1-2 cord.
3. ψnear = φiner / φ1-2.
4.ψ = φi / φ1-2.

64. What parameter of operation of a marine diesel engine is the most important limiting parameter when changing engine operating modes, which occur on average every 5 minutes (with intervals from 2 to 20 minutes) and within very wide limits?

1.Time of injectivity.
2. Thermal tension of parts of the CPG, gas turbine blades.
3. Maximum cycle pressure.
4.Maximum smoke level of exhaust gas during the period of p.p.

65. What are the similar cycles of steady-state (SD) and unsteady modes UM of operation?

1. Cycles after stabilization of the thermal state of the engine.
2. Cycles in which nur = nnur with the same power of the UR and UM.
3. Cycles in which nur = nnur and hpur = hpnur.
4. Cycles in which nur = nnur and hpur = hpnur, Tcoolur = Tcoolnur.

66. What type of unsteady mode is typical for a diesel engine of a road construction machine, for example, an excavator?

1. Irregular.
2. Oscillatory.
3. Cyclic.
4. For n = const.

67.Select the main source of nitrogen oxides in the exhaust gas of the internal combustion engine.

1.Air nitrogen.
2. Nitrogen-containing substances in fuel.
3. Nitrogen-containing additives for motor oils.
4. Nitrogen-containing substances in fuel and oil.

68.Functional catalytic converters

1.Reduce CO, CH, NOx emissions.
2. Reduce CO and CH emissions, but do not reduce NOx.
3.Reduce NOx emissions, exhaust gas smoke, dispersed particles, but do not reduce CO and CH.
4.Reduce CO2, CH and NOx emissions.

69. The use of adsorbers in catalytic converters allows

1. to reduce emissions of harmful substances during the test cycle as a whole.
2.Use oxidizing converters to reduce NOx emissions.
3. to reduce the cost of the neutralizer by reducing the platinum content.
4.increase the service life of the neutralizer.

70. Electric heating of the neutralizer is used for

1.Reducing the time of reaching the operating mode.
2. increasing its efficiency when working on lean mixtures.
3. burning off soot and other deposits on the catalyst.
4. Facilitation of starting the engine in winter at negative temperatures.

71. Choose the most effective way to spray liquids.

1.Mechanical.
2.Hydrodynamic.
3.Electrostatic.
4.Ultrasonic.

72. In what case is the fuel compressibility taken into account?

1.When filling the tank with fuel.
2.Only when calculating the fuel pump.
3.Only when calculating filters.
4. When calculating the fuel equipment as a whole.

73.Select the unit of measurement for the fuel compressibility factor β.

1. [MPa^{-1}].
2. [-].
3. [cm^3].
4. [1 / ºC].

74. What is the lubrication of most modern distribution type injection pumps?

1. Engine oil
2. Fuel for the engine.
3.Separately filled with oil in the injection pump.
4. Separately filled with fuel in the injection pump.

75. A homogeneous fuel-air mixture (FA) is

1. FAs, in which there is an equal number of oxygen molecules near each fuel molecule.
2. FAs, in which the fuel consists of molecules of the same size.
3. FAs, which consists of the same number of fuel and oxidizer molecules.
4. FAs, in which fuel and air are located in layers.

76. In what case is the best mixing of reagents observed?

1. If the volumes of the mixed components (gases) are approximately the same.

2. If the air / fuel mixture has a stoichiometric composition.
3.If the air volume is greater than the fuel volume.
4.If the air volume is less than the fuel volume.

77. What does the reduction in the diameter of the nozzle orifice of the nozzle lead to?

1.To increase the rate of fuel flow.
2. To reduce the rate of fuel expiration.
3. To increase the injection pressure and decrease the rate of fuel flow.
4. To reduce the fuel injection pressure.

78. What happens to the compressibility factor β with increasing pressure?

1. The coefficient of compressibility β increases.
2. The coefficient of compressibility β does not change.
3. The coefficient of compressibility β decreases.
4. The coefficient of compressibility β takes negative values.

79. Choose from the list the negative consequences of the effect of "post injection" of fuel:
a) the smoke of the exhaust;
b) excessive consumption of fuel;
c) coking of the injector nozzles.

1.Only a.
2.A, c.
3.Only b.
4.A, b, c.

80. What are the advantages of a distribution type injection pump in comparison with an in-line injection pump?

1. The use of a distribution type injection pump can significantly reduce the metal consumption and dimensions of high-pressure pumps, as well as reduce the number of expensive precision parts.
2. The distribution type injection pump has a longer resource.
3. Injection pump of distribution type allows you to easily carry out large cycle feeds.
4. The use of a distribution type injection pump can significantly reduce hydraulic losses in the discharge line.

81. What pushers in the injection pump are most widespread?

1. Roller.
2.Cutting.
3.Fungal.
4. Flat.

82. What is the purpose of the oxygen sensor?

1. Ensuring optimal performance of the catalytic converter.
2.Measuring the content of CO, NOx in the exhaust gas.
3. Ensuring the composition of the mixture with $\alpha = 1.0$.
4.Reduction of exhaust gas toxicity.

83.Select the tasks performed by the pressure valves in the split-type fuel equipment.

1. Creation of a predetermined residual pressure, correction of the speed characteristics of the fuel supply.
2.Improving the filling of the supra-plunger cavity.
3. Ensuring fuel cut-off in HPP.
4.Disconnection of the HPP and the supra-plunger cavity of the injection pump.

84. Purpose of the speed regulator in the injection pump -

1. stabilization of the frequency of rotation of the injection pump.
2.Changing the cyclic fuel supply.
3. regulation of the power of the internal combustion engine.
4.increase in the cyclic fuel supply to the VSC with a decrease in the rotational speed.

85. Appointment of the anti-corrector in the high-pressure fuel pump -

1.Increase in the cyclic fuel supply to the VSC with a decrease in the rotational speed.
2.Increase in the fuel supply to the VSC with a decrease in the rotational speed.
3.Reducing the fuel supply to the VSC with a decrease in the rotational speed to reduce the smoke of the exhaust gas.
4. Decrease in cycle feed with increasing speed.

86. Select the area of the running-in zone (Fig. 1) on the curve of the wear dynamics of the TA.

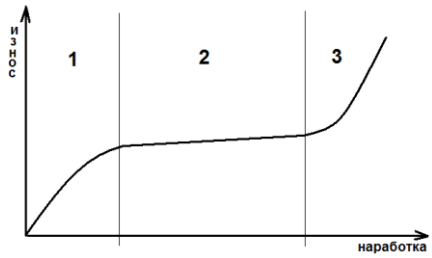

Fig. 1. TA wear dynamics curve.

1.Area 1 and 2.
2. Area 1.
3. Area 2.
4. Area 3.

List of questions to prepare for the main part of the state exam:

1. Thermodynamic cycles of piston engines. Working cycle parameters. Analysis of cycle indicators. Combined motor cycles.
2. Similarity criteria in the theory of working processes of internal combustion engines, methods of obtaining them.
3. Fuel systems of engines with internal mixture formation. Classification.
4. Composition and diagrams of low-pressure fuel systems.
5. Full life cycle of the internal combustion engine
2. Working bodies in the internal combustion engine. Fuels, oxidants, their main properties.
3. Internal combustion engine mathematical modeling. Classification of mathematical models.
4. Combustion reactions of liquid and gaseous fuels. Perfect, imperfect, complete and incomplete combustion of fuel

5. High pressure fuel pump design.
6. Design and calculation of the high pressure fuel pump and its elements.
7. The composition of the combustible mixture and combustion products. Heat of combustion of a combustible mixture.
8. Basic concepts of the mathematical theory of experiment.
9. Gas distribution phases. Processes of release, filling, purging.
10. Design and calculation of injectors and pump injectors, their static hydraulic characteristics, methods of closing injectors.
11. Microprocessor-based ignition timing control system.
12. Gas exchange processes in engines. Parameters of the working fluid in the cylinder at the end of the discharge and charging processes. Gas exchange in 4-stroke engines.
13. Perfect, imperfect, complete and incomplete combustion of fuel. Stoichiometric amount of air, excess air ratio.
14. Heat capacity and internal energy of the mixture and combustion products and cylinder recharge.
15. Multi-fuel engine systems and heavy fuel delivery systems.
16. Diesel turbocharging systems.
17. Indicators of gas exchange processes. Total excess air ratio.
18. Gas exchange schemes. Main periods of gas exchange
19. Sources of noise in reciprocating engines. Methods for measuring engine noise and vibration. Measurement of the total noise level and the noise level of individual sources.
20. Accumulator fuel supply systems in electronically controlled diesel engines. Electrohydraulic nozzles. Special high pressure pumps.
21. Main dosing and carburetor auxiliary systems. Multi-chamber carburetors
22. Gas exchange in 2-stroke engines. Real and geometric compression ratio
23. Filling and residual gas ratios
24. Equipment for boxes and laboratories. Test benches. Hydraulic, electric and inductor brakes and their characteristics. Coordination of brake and motor characteristics.
25. Microprocessor-based mixture control systems.
26. Fuel equipment of engines with external mixture formation. Fuel supply methods. Carburetion, injection and mixture formation. Carburetors.
27. The main periods of gas exchange. Coefficients of filling, residual gases, excess purge body, purge, cleaning efficiency.
28. Measurement of stationary and non-stationary temperatures and heat fluxes in the internal combustion engine. Measurements of temperatures in the engine cylinder. Collectors, contactless methods of transmitting signals from sensors.
29. Smoke detectors. Measurement of particulate matter in exhaust gases.
30. Gasoline injection systems into the intake manifold. Pneumatic and electronic regulation. Central and distributed injection. Designs of pumps, nozzles and actuators.
31. Measurement accuracy assessment.
32. Compression process. Physical and chemical processes occurring in the working fluid during the compression process. Features of compression processes in engines with split combustion chambers.
33. Measurement of fuel consumption during tests of internal combustion engines
34. Methods for chemical analysis of gases in ICE research. Classification of gas analyzers
35. Purpose and principle of operation of the lambda probe.
36. Cylinder injection systems. Quantitative and qualitative methods of power regulation with direct injection.

37. Mixing processes in engines. Indicators of the quality of the combustible mixture. External and internal mixture formation.
38. Analysis of heat release by indicator diagrams.
39. Measurement of stationary and variable pressures. Sensors for measuring fast-changing pressures. Indication.
40. Motor fuels and their properties.
41. Gas engine power systems. Gas equipment for internal combustion engines with forced and prechamber-flare ignition. Cylinders, evaporators, reducers, pressure regulators, gas mixers, valves.
42. Evaporation of droplets and films of liquid fuels. Spraying methods for liquid fuels and suspensions. Droplet sizes and spray patterns. Volumetric, film, volume-film and layer-by-layer internal mixing.
43. The use of a computer when testing an internal combustion engine.
44. Measurement of stationary and instant flow rates of liquids and gases. Hot-wire anemometer and laser Doppler velocity meter. Ion anemometer.
45. Comparison of characteristics of supercharged and internal combustion engines.
46. Fuel supply systems for gas-liquid engines. Gas diesel power systems. Composition of systems and methods of control, design of elements.
47. Ignition of combustible mixtures. The spread of the flame through the volume of the combustion chambers. Combustion phases. Concentration limits of flame front propagation.
48. Calculation of the parameters of the working fluid during the combustion period.
49. Measurement concept. Measurement errors. Types of engine tests. GOSTs for testing.
50. Output recorders for ICE tests.
51. Cooling systems. Classification, basic schemes. Liquid cooling systems. Coolants and their characteristics.
52. Combustion in divided and undivided chambers. Flame front propagation speed, heat release characteristics, ignition delay period, combustion duration, maximum combustion pressures, pressure rise rates
53. Features of the design of diesel engines of passenger cars
54. Conversion of non-electrical quantities to electrical ones. Primary converters. Amplifiers. Shapers
55. Analog-to-digital converters.
56. Air cooling system, diagram, design of deflectors.
57. Lubrication systems, classification, diagrams, system elements and the calculation of their characteristics.
58. Experimental Methods for Studying Combustion in Reciprocating Engines.
59. External speed characteristic and its correction.
60. Forces and moments acting in the engine. Internal and external engine imbalances.
61. Intake and exhaust systems. Pipelines. Air filters. Charge air coolers.
62. Distributed petrol injection systems.
63. Toxicity of combustion products of exhaust gases from internal combustion engines, ways to reduce it. Mechanisms for the formation of toxic substances.
64. Engine balancing methods.
65. Noise and vibration in engines and their sources. Reduced noise and vibration.
66. Methods for starting engines. Starting qualities. Ways to make it easier to start.
67. Silencers at the inlet and outlet. Setting up systems. Calculation methods and structural analysis

68. Expansion process. Heat transfer to the walls, afterburning of fuel. Calculation of the state of the working fluid in the process of expansion.
69. Loading devices for testing the internal combustion engine.
70. Classification of piston engine mechanisms transforming the movement.
71. Light fuel injection systems. Mono injection and distributed injection. Advantages and disadvantages.
72. Three-way exhaust gas catalysts.
73. Indicator and effective indicators of engines. Average indicator pressure. Specific indicator fuel consumption
74. Principles of calculating and plotting the oncoming torque diagrams and calculating the engine flywheel.
75. Accumulator fuel supply systems for diesel engines. Classification, basic schemes. Advantages and disadvantages.
76. Methods for neutralizing exhaust gases. Afterburning, catalytic neutralization, chemical absorbers. Exhaust gas recirculation.
77. Kinematics of the crank mechanism.
78. Thermodynamic cycles of piston engines. Working cycle parameters. Analysis of cycle indicators.
79. Principles of approximation of the dynamics of heat release in the simulation of internal combustion engines.
80. Foundation frames, struts and beds, crankcases and pallets, structural analysis, materials, strength calculation.
81. Diagnostics of engines at transient operating conditions.
82. Thermal balance of the engine. Heat recovery systems.
83. Components of mechanical losses. Average friction pressure, power of mechanical losses, mechanical efficiency.
84. Combined motor cycles
85. Cylinders and cylinder blocks, bushings and cylinder heads (covers). Analysis of structures, materials, strength calculations.
86. Engine diagnostics systems. Types of diagnostics. Methods and possibilities of CIP diagnostics. Means for providing diagnostics of engines and its systems.
87. Fuel equipment of split type diesel engines. Types of high-pressure fuel pumps, operating principles, disadvantages.
88. Average effective pressure, effective engine power. Specific, effective fuel consumption, effective engine efficiency.
89. The method of the planned experiment.
90. Valve arrangement. Calculation of the strength of the parts of the gas distribution mechanism.
91. High-speed characteristics of diesel fuel supply. Proofreaders and anticorrectors of cyclic fuel supply.
92. Methods for increasing the effective engine power. Liter power, piston power, combined indicators.
93. Gas distribution bodies for two-stroke engines; slide valve timing.
94. Varieties of nozzles for distributed injection systems of light fuel. Methods for testing and checking injectors.
95. Exhaust gas recirculation.
96. Aspiration as a way to increase the specific power of the engine. Combined engine diagrams. Pressurization systems.

97. Characteristics of motor fuels.
98. Plain and rolling bearings. Fundamentals of the hydrodynamic theory of lubrication. Load bearing capacity.
99. Standardized harmful substances in the composition of the exhaust gas of the internal combustion engine.
100. Gas turbines for pressurizing internal combustion engines. Active and jet, axial and radial turbines.
101. External and internal heat balances of engines. Heat balance components. Heat transfer in engines and heat density of parts.
102. Internal combustion engine lubrication system.
103. Drive systems and valve timing control. Mechanical, pneumohydraulic and electromagnetic valve drives.
104. ICE toxicity and methods of its reduction.
105. Unit injectors. Classification, principle of operation. Advantages and disadvantages compared to split type TA.
106. Modes of operation and characteristics of engines
107. Operational fuel consumption and methods of its reduction.
108. Connecting rods, connecting rod rods, piston and crank heads of connecting rods, connecting rod bolts and their strength calculation.
109. Alternative fuels for internal combustion engines.
110. Methods for regulating the operation of engines (qualitative, quantitative, mixed regulation, regulation by changing the working volume).
111. Joint work of engines and power consumers.
112. Crankshafts and flywheels, determination of their basic dimensions and strength calculation.
113. Diesel fuel supply equipment tests.
114. Characteristics of positive displacement and centrifugal compressors and gas turbines.
115. Optimization of engine workflow. Optimization criteria. Optimization constraints. Optimization parameters.
116. Methods for determining the octane and cetane numbers of fuel.
117. Assessment of the strength of engine units and parts taking into account variable mechanical and thermal loads. Parameters characterizing the reliability of motors.
118. The concept of the external speed characteristic of the internal combustion engine. Types of speed characteristics.
119. Automatic control systems (ACS) and regulation (ACS). Engine and regulator as elements of the automatic control system. Steady and unsteady modes of operation. Static and dynamic characteristics. Stability of motors, self-leveling.
120. Internal combustion engine lubrication system. Its main tasks, structural elements.
121. Pistons, piston pins and rings. Calculation methods.
122. Smoke of exhaust gases and methods of its reduction.
123. Coordination of the characteristics of the piston engine and supercharging units.
124. Direct acting regulators. Static characteristics. Indirect regulators. Actuators for regulators. Servo motors. Constructive schemes and principle of operation.
125. Differences between thermodynamic and actual ICE cycles.
126. The main indicators characterizing the design of engines. Complete engine life cycle. Design stages, computer-aided design.

127. Direct injection of gasoline into the internal combustion engine cylinder. Classification of systems, basic schemes, influence on the effective and toxic indicators of the engine.
128. Pressurization system of a piston internal combustion engine with a wave pressure exchanger
129. Fuels for engines with positive ignition. Knock resistance of gasoline and its assessment. Assortment of gasoline. New types of fuels.
130. Internal combustion engine filling ratio
131. Methods for calculating the strength of engine parts. Selection of design modes.
132. Gas distribution mechanism of a 4-stroke internal combustion engine. Varieties, main purpose.
133. Compression ignition engine fuel. Fuel classification. Flammability of fuels and methods for its assessment. Fuel additives.
134. Strength calculation of CPG parts.
135. Cetane number and its influence on starting and working process of a diesel engine.
136. Principles of operation and classification of piston engines. Features of the device and operation of certain types of piston internal combustion engines.
137. Methods for improving the operational fuel efficiency of reciprocating internal combustion engines.
138. Gaseous fuels. Natural, associated, industrial and generator gases. Properties of gaseous fuels. Compressed and liquefied gases.
139. Increasing the resource of the internal combustion engine.
140. General principles of engine design. Layout diagrams of engines. Type, power series, aggregation.
141. Principles of dosing fuel in accumulator fuel supply systems of diesel engines. Fuel injection characteristic in the CR system.
142. Improving the fuel efficiency of the internal combustion engine in transient operating modes.

Approximate topics of final qualifying works:

Method for determining the natural frequencies and the form of torsional vibrations of the equivalent system of the crankshaft of a four-cylinder four-stroke in-line piston engine

Analysis of the use of biofuels in internal combustion engines

Assessment of methods for reducing harmful emissions from internal combustion engines of passenger cars

Investigation of the features of the indicator process in engines with ignition of a homogeneous mixture from compression

Investigation of the influence of additives of alternative types of fuel of plant origin on the technical and economic indicators of a diesel engine

Study of the possibility of increasing the technical and economic indicators of the engine by optimizing the valve timing

Piston skirt profiling with regard to hydrodynamic lubrication

Thermodynamic analysis of the possibility of increasing the technical and economic indicators of the engine using the Miller cycle

Mathematical modeling of hydrodynamic lubrication of compression wheels

Analysis of possible ways to reduce fuel consumption during the operation of a passenger car engine

Evaluation of the detonation ability of gas engine fuels for spark ignition engines based on detailed chemical models of spontaneous ignition of natural and associated gas

Analysis of changes in power indicators of gasoline internal combustion engines for passenger cars when using additional equipment

Increasing engine power by optimizing valve timing

Combined method for evaluating knock in spark ignition engines based on detailed chemical models of fuel autoignition

Analysis of changes in the power of a gasoline internal combustion engine of a passenger car under operating conditions

Assessment of the influence of operating conditions on the characteristics of the internal combustion engine

Analysis of the features of the process with the ignition of a homogeneous mixture from compression

The influence of the variable valve timing system on engine performance

Method for determining the load on the main journals of a V-shaped 6-cylinder four-stroke engine with a camber angle of 90 ° and an angular displacement of the connecting rod journals of adjacent connecting rods

Technique for removing the load characteristic on a motor unit with a single-cylinder small-sized gasoline engine

Technique for removing the control characteristics for the ignition timing on an engine unit with a single-cylinder small-sized gasoline engine

Possibilities of increasing the operational fuel efficiency of a ship diesel engine

Application of accumulator fuel supply systems with high injection pressures in order to ensure the norms of toxicity and smokiness EURO-4 and 5 for diesel engines for automotive purposes

The use of an ultrasonic method for cleaning pretentious parts of diesel fuel equipment in order to increase its service life

Analysis of modern methods and equipment for diagnosing internal combustion engines of cars

Methodology for planning maintenance and repair work at the workshop

Modernization of the fuel supply system of an autotractor diesel engine in order to improve economic and environmental performance

Modernization of the lubrication system of the Honda CBR 600 engine in order to eliminate oil starvation

Improving the efficiency of internal combustion engines in operating conditions

Analysis of modern additives to motor oils that increase the durability of internal combustion engines

Analysis of modern ICE repair technologies

Reducing the smoke and toxicity of diesel using water-fuel emulsions

Development of a method for diagnosing a high-pressure fuel pump of a distribution type

Use of charge air cooling to improve the economic and environmental performance of a diesel engine

Improving the efficiency and environmental friendliness of a diesel engine by using palm oil additives in fuel

10.4 Methodological materials defining the procedures for assessing the results of mastering the educational program

Methodology for assessing the results of the state exam

Based on the results of two stages of the state exam, a total score is given in accordance with the point-rating system adopted by the RUDN University (score / ECTS / RF score).

In the first stage (test part), the student can receive a maximum of 20 points. The assessment received by the student at the first stage is formed on the basis of the test result issued by specialized software and is put on the list of the state examination and the minutes of the SEC meeting.

In the second stage, the student can receive a maximum of 80 points. The score is determined based on the results of checking the student's written answer to the exam ticket and (if necessary) the quality of the student's answers to additional questions from the SEC members. The grade received by the graduate following the results of the second stage of the state exam is also put on the list of the state exam.

The total score received by the student following the results of the state exam is put down in the examination sheet (by the chairman of the SEC), in the minutes of the SEC meeting (by the secretary of the commission) and communicated to the graduate.

If at one of the stages of the state exam a student receives "0" points or does not appear for the exam test without a valid reason, then the result of passing the state exam by such a student is "unsatisfactory".

Methodology for evaluating the results of FQW defense

For the efficiency and convenience of the work of the SEC members, it is recommended to provide them with a supporting document "Worksheet for assessing the formation of competencies during the SEC", the form of which is given in Appendix 1.

In the process of defending the FQW, the members of the State Electoral Commission give points for each of the above indicators. At the end of the defense, each of the members of the GEC sums up all the assigned points.

The final assessment of the formation of competencies is an assessment based on the results of the defense of the FQW. To determine the final grade, it is necessary to calculate and round off the arithmetic average of the grades given by all members of the state commission. In the event of any controversial issues, the chairman of the SEC has a casting vote.

The total score received by the student as a result of the defense of the FQW is put down in the examination sheet (by the chairman of the SEC) and in the minutes of the SEC meeting (by the secretary of the commission).

The program has been drawn up in accordance with the requirements of the OS of VO RUDN.

Developers:

Associate Professor of the Basic Department of Power Engineering		P.P. Oshchepkov
position, department name	signature	initials, surname

Program Manager:

Associate Professor of the Basic Department of Power Engineering		P.P. Oshchepkov
position, department name	signature	initials, surname

Head of the Department:

Basic Department of Power Engineering		Yu.A. Radin
position, department name	signature	initials, surname

Annex 1

WORK SHEET **assessing the formation of competencies during the SFA**		
Direction of training:		
Educational program (profile / specialization):		
Full name of the member of the SEC:		
Date:		
Qualification test:	*FQW defense*	
Full name of the graduate:		
Indicators for assessing the defense of FQW	**Maximum score**	**Actual score**
- correspondence of the content of the FQW to the approved topic and the issued assignment, clarity of the formulation of the goals and objectives of the study	20	
- reliability, originality and novelty of the results obtained in the FQW	10	
- the practical value of the completed FQW	10	
- style of presentation of the FQW	5	
- compliance with the approved requirements for the design of FQW	10	
- the quality of the presentation and report during the defense of the FQW	10	
- the quality of answers to questions during the defense of FQW	10	
- assessment of the FQW by the head (review)	10	
- assessment of FQW by a reviewer (review)	0	
- availability of publications on the topic of work, certificates, awards, etc.	5	
Points total:	100	
SEC member's signature		