



RUDN
university



ACADEMY
OF ENGINEERING



INTERNAL COMBUSTION ENGINES

MASTER'S PROGRAMME DEGREE



ADVANTAGES OF THE PROGRAM

- ✔ Knowledge of theoretical issues in the theory of work processes, design and mathematical modeling of heat engines allows graduates to work in any region of the world.
- ✔ Due to the international composition of the study group, you compare the features of engine operation in different countries and climatic conditions.
- ✔ Training feature - a large number of hours are allocated to research and practice.
- ✔ Lectures and master classes by practitioners of various organizations and graduates of the program are regularly held.
- ✔ The opportunity to participate in the student exchange program with partner universities.



STUDYING PROCESS



120 credits.

Lectures, practical exercises and independent work
several types of practice



MATHEMATICAL MODELING OF THERMAL PROCESSES

- The principles of mathematical modeling.
- Simulation concepts in mechanics.
- Elementary mathematical models.
- Getting models from the fundamental laws of nature.
- Conservation of the mass of the substance. Energy saving.
- Conservation of the number of particles. Joint application of several fundamental laws.
- The concepts of gas dynamics.
- Equations of gas dynamics in Lagrangian coordinates.
- The study of mathematical models.
- Application of similarity methods.
- Application of dimensional analysis to the construction of exact particular solutions to problems of mathematical physics.
- Dimension analysis and transformation groups.



COGENERATION PLANTS BASED ON HEAT ENGINES

- Cogeneration, trigeneration.
- Secondary Energy Resources.
- Classification.
- Thermal balance of engines.
- Cogeneration plants based on steam turbine plants.
- Cogeneration plants based on gas turbine units.
- Cogeneration plants based on internal combustion engines (ICE).
- Accounting and regulation of energy consumption.



- Heat pump installations. Organization and stimulation of energy saving.
- Economic incentive.
- Cogeneration in Russia and abroad.
- Energy planning, energy audit.
- Renewable energy production.
- Hydropower Wind power. Solar energy.
- Bioresources. Geothermal energy.
- Classification of heat pump units (HPU).
- Characterization of low-grade heat sources.
- Theoretical foundations of steam compression heat pump units.
- Ways to improve the efficiency.
- Working agents. Problems of using freons.
- Montreal Protocol, Kyoto Agreement and the Paris Climate Agreement.
- The characteristic of the secondary resources of a heat engine.



ICE TEST METHODS

- Types of experimental studies, planning concepts and experimental design, screening and extreme experiments, reduction in the number of variables.
- Probability theory in experimental practice, distribution function of random variables.
- Variational series, statistical characteristics, variance, errors.
- Dispersion analysis, factor analysis, correlation analysis, regression analysis.
- Planned experiment, checking the adequacy of mathematical models.
- Comparison, documentation and presentation of experimental data.
- Test methods for ICE.
- Theory of measurements and instrumentation.
- Electrical measuring systems. Determination of engine power.
- Speed measurement Pressure measurement.
- Temperature measurement. Cost measurement.



- Gas analysis. Determination of engine toxicity.
- Indication of engines.
- Determination of noise and vibration of the internal combustion engine.
- Determination of the characteristics of the internal combustion engine.



PATENTING

- International and regional patent systems.
- Legal acts relating to invention.
- Technical creativity.
- Stages of creating new technology.
- The Five Commandments of the Inventor.
- The concept of the invention.
- Patentability criteria.
- Types of objects of inventions.
- Claim.
- Patent for an invention.
- The relationship between the author and the patent holder.
- Use of the invention.
- Patent infringement.
- Other rights of authors and patent holders, including copyright and related rights.
- The unity of invention.
- The definition of the object of the invention.
- Analog and prototype.
- Information Search.
- Drafting search rules. Search for a prototype Identification of the criterion of “Novelty.”
- Identification of the criterion of “Inventive step”.
- Identification of the criterion of “Industrial applicability”.
- Application for invention.



- Description of the invention. Formal and patent examination.
- Chamber of Patent Disputes, types of fees, publication of information about the application, issuance of a title of protection.
- The concept of a utility model. Registration and examination of an application for a utility model.
- Ergonomic and aesthetic requirements for products.
- Industrial design (definition, purpose and examination).
- Trademark (definition and purpose and examination).
- Rationalization proposal.
- Making an application for a rationalization proposal.
- Rationalizer Rights.



PROBLEMS OF REDUCING HARMFUL EMISSIONS OF INTERNAL COMBUSTION ENGINES

- ICE operation and ecology.
- Toxicity of fuels and their combustion products in internal combustion engines.
- International and domestic legal and regulatory technical documentation for the assessment of emissions of harmful substances and smoke.
- Methods for estimating emissions of harmful substances from the internal combustion engine exhaust gases.
- Equipment for measuring the content of harmful substances, soot and dispersed particles in the exhaust gases of the internal combustion engine.
- Toxicity test cycles. Physico-chemical processes of the formation of toxic components in internal combustion engines.
- Methods of reducing the toxicity of internal combustion engines by affecting the work process.
- The influence of design and regulatory factors on the emission of harmful substances from the exhaust gases of the internal combustion engine.
- Methods of additional exhaust gas treatment for internal combustion engines.
- Mathematical modeling and design optimization of ICE according to toxicity parameters.
- ICE maintenance and emissions.
- The use of alternative fuels and hybrid power plants to reduce emissions.



ICE FUEL SUPPLY SYSTEMS

- Light fuel injection systems, their classification and features.
- Central and distributed injection, advantages and disadvantages, basic design schemes.
- The impact of electronic fuel management on the performance of gasoline ICEs.
- The basic principle of automobile engine management.
- Analysis of the command parameters of the fuel metering.
- Pressure measuring instruments, air and fuel flow meters for gasoline internal combustion engines and diesel engines.
- Contact and proximity sensors.
- Direct injection of light fuel into the engine cylinder.
- Effects on effective and toxic engine performance.
- Diesel fuel system. Direct fuel equipment.
- Methods for regulating the cyclic fuel supply.
- Individual and block fuel pumps of a high pressure.
- Injection pump distribution type.
- Features of regulation of cyclic feed. Pump - nozzles. Diesel nozzles.
- Battery-powered fuel systems.
- Feed management. Injection pump and injectors for battery systems.
- Optimization of fuel supply equipment.
- General issues of the development of diesel control systems.
- The capabilities of these systems in solving the problem of creating economical and environmentally friendly diesel engines.
- The principles of construction and classification of control systems.
- Evaluation of fuel equipment of various types from the point of view of the organization of fuel supply process control.
- Systems of electronic diagnostics of modern fuel supply equipment.
- Study of the design of modern fuel supply systems for gasoline ICE.
- Sensors and air flow meters, λ probes.
- Fuel supply pumps and nozzles, pressure regulators



SPECIAL CHAPTERS OF THE THEORY OF HEAT ENGINES

- Thermodynamic justification for the use of ICE pressurization.
- Compressors Turbochargers Modification of the engine using gas turbine boost.
- Ignition systems. Engine starting systems. Exhaust gas inlet and outlet systems.
- Intake and exhaust manifolds and intercooler.
- Supercharged engine with positive ignition.
- Special boost systems.



SPECIAL CHAPTERS OF THE THEORY AND DESIGN OF INTERNAL COMBUSTION ENGINES

- Principles of calculation and design of internal combustion engines.
- New materials in engine building.
- Kinematics and dynamics of ICE.
- The balancing of the internal combustion engine.
- The design of the main parts of the internal combustion engine.
- Calculation of ICE elements.
- Optimization of ICE work processes.
- Strength analysis of ICE elements.



STUDENT REVIEWS



CAMPOS MESSIAS DE JESOUCHE AUGOUSTOU, ANGOLA

“ First of all, I must say that I am positively surprised with the level of readiness of this Department for the formation of specialists in the field of internal combustion engine. The program includes several subjects that stimulate scientific professional research, which personally gave me the opportunity to turn scientific theoretical ideas into scientific innovative projects with registration of patents applications. ”



ШААБО ИССА, ЛИВАН (ISSA SHAAVO, LEBANON)

“ I studied my master’s degree at RUDN University in the field of mechanical engineering and instrumentation 2017-2019. I am very grateful to the entire pedagogical staff for all what they have done to us over these 2 years. Almost all of our group defended their diplomas and took a degree of 4 and 5, and this is certainly a blessing for managers. I recommend all students who already Bachelor’s Degree to apply for this course, because here they will find the support they need during this period. and of course they will be surrounded by teachers who give them all the necessary knowledge to become highly qualified students. ”



HEAD OF THE PROGRAMME

PYOTR PLATONOVICH OSHCHEPKOV



PhD in Technical Sciences, Associate Professor of the Department of Mechanical Engineering and Instrument Engineering, Head of the Department of Power Engineering.

FIELDS OF SCIENTIFIC INTERESTS:

alternative fuels for internal combustion engines, issues of operation of internal combustion engines in various conditions.

Author of scientific articles in peer-reviewed Russian and foreign scientific journals (Higher Attestation Commission, SCOPUS, Web of Science).

Regularly makes presentations at Russian and international conferences on energy and heat engines. Co-author of the training manual "ICE Systems".