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**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 programme developer)

Department of Subsoil Use and Oil and Gas Engineering

(department realizing the PhD program)

COURSE SYLLABUS

Chemical technology for fuels and high-energy substances

(course title)

Scientific specialty:

2.6.12. Chemical technology for fuels and high-energy substances

(scientific specialty code and title)

The course instruction is implemented within the PhD programmes:

Chemical technology for fuels and high-energy substances

(PhD program title)

1. DISCIPLINE (MODULE) GOAL

The objective of mastering the discipline «Chemical technology for fuels and high-energy substances» is to prepare for surrender candidate exams, and same the acquisition of knowledge, skills and experience in the research field, characterizing the stages of the formation of competencies and ensuring the achievement of the planned results of the development of the educational program.

The main objectives of the discipline are:

- deepening and expanding theoretical knowledge in the field of chemical technology of fuels and high-energy substances;
- mastering of methods and means of scientific research of chemical technology of fuels and high-energy substances;
- systematisation of knowledge in the field of chemical technology of fuels and high-energy substances;
- formation of skills in applying various methods of improving hydrocarbon field development processes
- prepare for the Candidate's Examination in Chemical Technology of Fuels and High Energy Substances

2. REQUIREMENTS TO PHD-STUDENTS ON FINISHING THE COURSE

Mastering the discipline "Chemical technology for fuels and high-energy substances" is aimed at preparing for the candidate's examinations, as well as mastering the following competencies:

- Ability to solve innovative problems in the field of chemical technology of fuels and lubricants;
- Mastery of methodology of theoretical and experimental research in the field of specialty "Chemical technology of fuels and high energy substances";
- Ability to design and carry out complex research including interdisciplinary, on the basis of holistic systematic scientific outlook using the knowledge in the field of history and philosophy of science;
- ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical tasks including interdisciplinary ones;
- Ability and readiness to use laboratory and instrumental facilities to obtain scientific data;
- the ability and readiness to develop new research methods and their application in independent research activities in the field of chemical technology, taking into account the rules of copyright observance;
- the ability and willingness to analyze, summarize and publicly present the results of the scientific research carried out;
- Mastering the culture of scientific research in the field of chemical technologies, including the use of the latest information and communication technologies;
- the ability and readiness to organize and conduct basic and applied scientific research in the field of chemical technologies

3. WORKLOAD OF THE DISCIPLINE AND TYPES OF ACTIVITIES

The overall workload of the discipline «Chemical technology for fuels and high-energy substances» is 3 credit units (108 academic hours).

Types of activities	Total ac. hrs.	Semesters
		3
<i>Classroom activities (total), including:</i>	60	60
в том числе:		
Lectures (LC)	30	30
Laboratory activities (LA)	—	—
Practical lessons/Seminars (PC)	30	30
<i>Independent work</i>	48	48

<i>Intermediate certification (test with assessment/exam)</i>		36	36
Overall workload	ac. hrs.	108	108
	credits	3	3

4. CONTENT OF THE DISCIPLINE

Name of the discipline section	Contents of the section (topic)	Type of study work
Section 1: Technology for Primary Crude Oil and Solid Fuels Processing	<p>Topic 1.1. Chemical composition of oil, natural gas, associated petroleum gas and gas condensate. Technological and chemical classification of oil. The fractional composition of oil. Characteristics of the main fractions produced by distillation of oil and fuel oil.</p> <p>Topic 1.2. Directions of oil refining: fuel, fuel-oil, petrochemical and integrated. Classification of oil, gas and gas condensate refining processes. Physical and chemical processes. Shallow refineries. Flow chart of the shallow refineries.</p> <p>Topic 1.3. Fundamentals and technology of oil treatment processes. Collection of oil and gas in the fields. Preparation of oil in the fields. Dewatering and desalting of oil. Requirements for oil delivered from the fields. Formation of oil emulsions. Types of emulsions. Emulsifiers and demulsifiers. Methods for breaking of oil emulsions. Demulsification requirements for demulsifiers.</p> <p>Topic 1.4 Desalting and dehydration of crude oil in electric desalting unit (EDSU). Influence of temperature, pressure, electric field strength on electrodesalting process. Technological scheme of the electrodesalting unit. Stabilization of oil. Technological scheme of oil stabilisation plants. The influence of dissolved gas content in oil</p> <p>Theme 1.5 Oil refining in oil refineries. Options for technological schemes of oil refining for the fuel variant with deep and shallow refining and petrochemical variant. Basic technological schemes of installations of primary distillation of oil atmospheric tube (AT). The schemes with single and double evaporation of oil, with preliminary evaporation of light fractions. Advantages and disadvantages of each scheme. Technological scheme of the AT unit with double oil evaporation.</p> <p>Topic 1.6. The main schematic diagrams of vacuum tube (VT) distillation of fuel oil. Advantages and disadvantages of each scheme. Methods of vacuum generation in HT units. Secondary distillation of the broad gasoline fraction. Variants of distillation of gasoline on fuel and petrochemical variant. The technological scheme of installation of secondary distillation of a wide gasoline fraction. Combination of ELOU, AT, BT units, secondary distillation of gasoline. Advantages of the combined installations. Flowchart of the combined distillation unit ELOU-AVT with secondary distillation of gasoline.</p> <p>Theme 1.7 Cleaning petroleum products with alkali. Process chemistry. Technological units for lye treatment of hydrocarbon gases, fuel fractions.</p>	LC, PC

Section 2: Technology for deep refining of petroleum and solid fuels	<p>Topic 2.1. Thermal processes. Classification, purpose. Chemistry and mechanism.</p> <p>Theme 2.2. Thermal cracking. Purpose, raw material, process conditions, classification. Products and quality. Visbreaker. Purpose, feedstocks, process conditions, classification. Products and their quality. Process scheme with a bypass chamber, material balance. Coking. Purpose, raw materials, technological conditions, classification. Products and their quality. Technological scheme of delayed coking unit, fluid coking, flexi-coking; material balances.</p> <p>Theme 2.3. Pyrolysis. Assignment, raw material, technological conditions, classification. Products and their quality. Technological scheme, material balance.</p> <p>Topic 2.4. Bitumen production. Assignment, raw materials, technological conditions, classification. Products and their quality. Technological scheme of oxidated bitumen production, material balance. Production of TU. Purpose, raw materials, technological conditions, classification. Products and their quality.</p> <p>Theme 2.5. Thermocatalytic processes. Classification, purpose. Chemistry and mechanism.</p> <p>Theme 2.6. Catalytic cracking. Purpose, raw materials, process conditions, classification. Catalysts, basic requirements. Products and their quality. Technological scheme of unit with lift reactor, millisecond,</p> <p>Theme 2.7. Catalytic reforming. Assignment, raw material, process conditions, classification.</p> <p>Topic 2.8. Thermo-hydrocatalytic processes. Classification, purpose. Chemistry and mechanism.</p> <p>Theme 2.9. Hydrotreating. Purpose, raw materials, process conditions, classification. Catalysts, main requirements. Products and their quality. Process flow diagram for gasoline, paraffin and diesel fractions.</p> <p>Topic 2.10. Hydrocracking. Assignment, raw materials, process conditions, classification. Catalysts, main requirements. Products and their quality. Technological schemes for light hydrocracking, deep hydrocracking and two-stage hydrocracking.</p>	LC, PC
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5. EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Room Type	Room Equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline
Class for Seminars	Room for seminar-type classes, equipped with a set of specialized furniture, board (screen) and technical / multimedia gadgets	Not necessary
Self-Work Class	Room for self-working (can be used for lecture and seminars activities), equipped with a set of specialized furniture, board (screen) and technical / multimedia gadgets and computers with an access to EIPES	Not necessary

6. METHODOLOGICAL SUPPORT AND LEARNING MATERIALS

Main readings:

1. Капустин В.М. Технология переработки нефти. В 4-х частях. Часть первая. Первичная переработка нефти. // М.: КолосС, РГУ нефти и газа им. И. М. Губкина, 2012. — 459 с. Часть вторая. Физико-химические процессы. //Москва: Химия, 2015. — 400 с. Часть третья. Производство нефтяных смазочных материалов. //Москва: Химия, 2014. — 328 с.
2. Ахметов С. А. и др. Технология и оборудование процессов переработки нефти и газа: Учебное пособие / С.А. Ахметов, Т.П. Сериков, И.Р. Кузеев, М.И. Баязитов; Под ред. С.А. Ахметова. — СПб.: Недра, 2006. — 868 с.; ил.
3. Смидович, Е.В. Технология переработки нефти и газа. Крекинг нефтяного сырья и переработка углеводородных газов / Е. В. Смидович. - 4-е изд., стер., перепеч. с 3-го изд. 1980г. - М.: Альянс, 2011. - 328 с. - ISBN 978-5-903034-97-0.

Additional readings:

1. Капустин В.М., Рудин М.Г., Кудинов А.М. Основы проектирования нефтеперерабатывающих и нефтехимических предприятий. – М.: Химия, 2012. – 440 с., ил.
2. Каминский Э.Ф., Хавкин В.А. Глубокая переработка нефти: технологический и экологический аспекты. – М.: Техника, 2001. – 383 с.
3. Справочник нефтепереработчика. Капустин В.М., Рудин М.Г., Кулес С.Г., 2018, М., Химия, 414с.
4. Мейерс, Р. А. Основные процессы нефтепереработки: Справочник: пер. с англ. 3-его изд. / [Р.А. Мейерс и др.]; под ред. О. Ф. Глаголевой, О. П. Лыкова. – СПб.: ЦОП «Профессия», 2011. – 944 с., ил.

Internet sources:

ELS RUDN University and third party EBS, to which university students have access based signed contracts:

- RUDN Electronic Library System, <http://lib.rudn.ru/MegaPro/Web> ;
- ELS University Library Online, <http://www.biblioclub.ru> ;
- EBS Urayt, <http://www.biblio-online.ru> ;
- ELS Student Consultant, <http://www.studentlibrary.ru> ;
- EBS Lan, <http://e.lanbook.com> ;
- EBS Trinity Bridge <http://www.trmost.ru>

Databases and search engines:

- Electronic fund of legal and normative-technical documentation, <http://docs.cntd.ru> ;
- Yandex search system <https://www.yandex.ru> ;
- Google search system <https://www.google.com> ;
- Reference database Scopus , <http://www.elsevierscience.ru/products/scopus>

Educational and methodological materials for students' self-work studying the discipline / module:

A course of lectures on the discipline «Chemical technology for fuels and high-energy substances».

7. ASSESSMENT TOOLKIT AND GRADING SYSTEM FOR MIDTERM ATTESTATION OF STUDENTS IN THE DISCIPLINE (MODULE)

Assessment toolkit and a grading system to evaluate the level of competences (competences in part) formation as the course results are specified on the TUIS platform.

DEVELOPERS:

Professor of the
Department of Subsoil Use

and Oil and Gas Engineering

HEAD OF THE DEPARTMENT

Associate Professor of the
Department of Subsoil Use
and Oil and Gas Engineering



V.M.Kapoustin

A.E.Kotelnikov