



СИЛАБУС НАВЧАЛЬНОЇ ДИСЦИПЛІНИ



«Modern processing technologies for hydrocarbon raw materials»

Code and name of the specialty	161 – Chemical technology and engineering	Faculty / Institute	Institute of Education and Science in Chemical Technologies and Engineering
The name of the educational and scientific program	Chemical technology and engineering	Department	Technology of Oil, Gas and Solid Fuel Processing

TEACHER



Denis Viktorovich Miroshnichenko, dvmir79@gmail.com

Doctor of Technical Sciences, Professor, Head of the Department of "Technology of Oil, Gas and Solid Fuel Processing" NTU "KhPI". Work experience - 18 years. Author of more than 270 scientific and education works. Leading lecturer in the following disciplines: "Classification of combustible minerals", "Synthesis based on combustible minerals", "Fundamentals of technologies for processing solid combustible minerals", "Equipment for the production of processing of solid combustible minerals"

GENERAL INFORMATION ABOUT THE DISCIPLINE

Summary	The course is aimed at mastering the theoretical and practical foundations of modern technologies for processing hydrocarbons. The following topics are considered: 1. Current trends in the development of oil and gas and coal complex of Ukraine; 2. The main directions of improvement of technological processes at oil refineries; 3. The process of slow coking in the schemes of refineries; 4. Modern processes of visbreaking in the schemes of refineries; 5. Modern processes that refine products and deepen oil refining. 6. Innovative reagents and materials that stimulate the extraction of hydrocarbons. 7. Development of production of polymeric materials.
Purpose and goals	To develop in the postgraduate student theoretical ideas and practical skills on methods of conducting research on modern technologies of hydrocarbon processing
Format	Lectures, laboratory work, consultations. Final control - exam.
Learning outcomes	Conduct own research on modern technologies for processing hydrocarbons.
Amount	The total volume of the discipline is 80 hours: lectures - 60 hours, laboratory work - 20 hours.
Prerequisites	"Recycling and resource conservation in the industry", "Materials and substances for modern technologies", "Synthesis based on combustible minerals".

Teacher's requirements

The graduate student is obliged to attend all classes according to the schedule, not to be late. Adhere to ethics of behavior. To pass the discipline you must have: a laboratory gown, a laboratory journal. Work with educational and additional literature, with literature on electronic media and on the Internet. When skipping lectures, an oral interview is held on the topic. Practice laboratory classes with the permission of the teacher. In order to master the required quality of education in the discipline requires attendance and regular preparation for classes. Without the personal presence of the graduate student the final control is not carried out.

STRUCTURE OF THE DISCIPLINE

Lecture 1	The current state of oil and gas complexes in the world and Ukraine	Lab 1	Research of processes of separation of oil and oil products by hydrocyclone and gravitational methods with definition of effective modes of cleaning	Individual work	1. Areas of use of oxygen, sulfur, nitrogen, halogen-containing hydrocarbons in petrochemical synthesis.
Lecture 2	World resources and oil fields	Lab 2	Research of properties and basic regularities of formation of two-phase currents at fluidization		2. Natural sources of hydrocarbons. Elemental, chemical, fractional compositions. Chemical and physical properties.
Lecture 3	Resources and deposits of natural gas and coal	Lab 3	Experimental distillation of light and dark oil products		3. Natural and associated petroleum gas. Elemental and chemical compositions. Processing processes.
Lecture 4	Fuel resources and deposits of Ukraine	Lab 4	Research of design and principles of operation of heat exchangers of different types for petrochemical productions		4. Natural sources of hydrocarbons. Coal, peat, oil shale. Ways of their processing.
Lecture 5	Dynamics of oil, gas and coal production in the world and in Ukraine	Lab 5	Experimental determination of saturated vapor pressure of petroleum products		5. Alternative sources of hydrocarbons: high-viscosity oils, heavy bitumens, gas hydrates, hydrocarbons from vegetable raw materials.
Lecture 6	Modern tendencies of development of oil and gas and coal complexes of Ukraine				6. Theoretical foundations of crystallization and membrane separation of hydrocarbons.
Lecture 7	The main directions of improvement of technological processes at oil refineries. 1. Fundamentals of thermocatalytic processes				7. Chemistry and kinetics of thermal transformations of hydrocarbons. Stages of the radical-chain mechanism of hydrocarbon conversion.
Lecture 8	The main directions of improvement of technological processes at oil refineries. 2. Fundamentals of distillation processes				8. Thermal conversions of alkanes and naphthenes, olefins and aromatic hydrocarbons, dienes, alkynes and mixtures of hydrocarbons.
Lecture 9	The main directions of improvement of technological processes at oil refineries. 3. Heat				9. Theoretical bases and industrial schemes of processes of one- and

	transfer of oil products. Calculation and analysis. Selection of heat exchangers.				two-stage dehydrogenation of paraffins. Production of isobutylene and butadiene.
Lecture 10	The main directions of improvement of technological processes at oil refineries. 4. Advanced technologies in the publishing of lubricants				10. Thermodynamics, mechanism, catalyst and schematic diagram of the process of dehydrogenation of olefins. Synthesis based on butadiene and isoprene.
Lecture 11	The main directions of improvement of technological processes at oil refineries. 5. Computer calculation and analysis of tubular furnaces				11. Thermodynamics, mechanism, catalyst and schematic diagram of the process of dehydrogenation of alkylaromatic hydrocarbons. Styrene production. Synthesis based on styrene.
Lecture 12	The process of slow coking in the schemes of refineries. 1. The process of coking crude oil				12. Thermodynamics, mechanism, catalyst and schematic diagram of dehydrogenation of alcohols.
Lecture 13	The process of slow coking in the schemes of refineries. 2. The process of thermal cracking				13. Theoretical foundations and industrial schemes of oxidative dehydrogenation processes.
Lecture 14	The process of slow coking in the schemes of refineries. 3. Analysis of the oil refining scheme, which provides the maximum depth of refining using visbreaking				14. Hydrogenation of olefinic, aromatic and acetylene hydrocarbons.
Lecture 15	Modern processes of visbreaking in the schemes of refineries. 1. Modern processes of processing of oil residues (fuel oil, tar) into motor fuels or for preparation of raw materials for catalytic processes				15. Hydrogenation of oxygen-containing compounds. Varieties and purpose of the process.
Lecture 16	Modern processes of visbreaking in the schemes of refineries. 2. The process of visbreaking of oil residues				16. Hydrogenation of nitrogen-containing compounds. Varieties and purpose of the process. Mechanism and catalysts.
Lecture 17	Modern processes of visbreaking in the schemes of refineries. 3. Technological design of industrial visbreaking equipment				17. Classification and purpose of alkylation processes of hydrocarbons. The mechanism of the process of alkylation of paraffins.
Lecture 18	Modern processes of visbreaking in the schemes of refineries. 4. Directions of use and improvement of visbreaking products				18. Assignment of alkylation processes of aromatic compounds. Mechanism and catalysts of benzene alkylation.
Lecture 19	Modern processes that refine products and				19. The mechanism and catalysts of

	deepen oil refining. 1. Thermocatalytic processes			the process of isomerization of n-paraffins.
Lecture 20	Modern processes that refine products and deepen oil refining. 2. Fundamentals of technology for the production of high-octane gasoline components from catalytic cracking gases			20. Mechanism, kinetics and catalysts of isomerization of aromatic hydrocarbons. Xylene isomerization technology.
Lecture 21	Modern processes that refine products and deepen oil refining. 3. Fundamentals of gyro-catalytic processes of crude oil refining			21. Mechanism, kinetics and catalysts of radical-chain oxidation.
Lecture 22	Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. 1. Inhibitors of corrosion and biocorrosion of metals			22. Purpose of oxidation of paraffins. Synthesis.
Lecture 23	Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. 2. Inhibitors of asphalt-resin-paraffin deposits			23. Varieties and chemistry of olefin oxidation processes. Oxidation of ethylene. Synthesis.
Lecture 24	Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. 3. Hydrogen sulfide absorbers			24. Physico-chemical properties and industrial methods of obtaining methanol. Synthesis.
Lecture 25	Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. 4. Solvents, demulsifiers, surfactants			25. Physico-chemical properties and industrial methods of obtaining ethanol. Synthesis.
Lecture 26	Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. 5. Catalysts for major refining processes			26. Physico-chemical properties and industrial methods of obtaining phenol. Synthesis.
Lecture 27	Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. 6. Additives and components of drilling and washing fluids			27. Physico-chemical properties and industrial methods of obtaining formaldehyde. Synthesis.
Lecture 28	Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. 7. Suppression of the formation of hydrates and clathrates. Decrease in oil viscosity			28. Physico-chemical properties and industrial methods of obtaining olefins. Synthesis.
Lecture 29	Development of production of polymeric materials. 1. Basics of processes for obtaining polymeric materials			29. Physico-chemical properties and industrial methods of obtaining acetone. Synthesis.

REFERENCES AND EDUCATIONAL MATERIALS

- Basic**
1. Технологія первинної переробки нафти і газу: підручник / П. Топільницький, О. Гринишин, О. Мачинський. – Львів: Видавництво Львівської політехніки. 2014. 468 с.
 2. Хімія нафти та газу: навч. Посібник / М.М. Братичак, В.М. Гунька. – Львів: Видавництво Львівської політехніки. 2017. 448 с.
 3. Моторні палива: властивості та якість: підручник / Сергій Бойченко, Андрій Пушак, Петро Топільницький, Казимир Лейда; за заг. ред.. проф. С. Бойченка. – К.: «Центр учбової літератури». 2017. 324 с.
 4. Альтернативні палива: підручник / А.Д. Кустовська, С.В. Іванов, Є.О. Бережний. – К.: НАУ. – 624 с.
 5. Якість і властивості товарних нафтопродуктів: навчальний посібник. – Львів. Видавництво «Левада». 2019. 204 с.
 6. Геология и нефтегазоносность Украины: учебное и справочное пособие. – Харьков: Курсор. 2007. 294 с.
 7. Основи транспорту природних вуглеводнів: посібник / Білецький В.С., Фик М.І. – Харків: НТУ «ХПІ». 274 с.
 8. Основи промислової нафтохімії: підручник. – Львів: Видавництво Національного університету «Львівська політехніка». 2008. 604 с.

- Optional**
1. Мачинський О.Я., Топільницький П.І. Гідрокрекінг. – Львів: Видавництво Львівської політехніки. 2011. 346 с.
 2. Андрієшин М.П., Марчук Я.С., Бойченко С.В., Рябокони Л.А. Газ природний, палива та оливи. – Одеса: Астропринт. 2010. 232 с.
 3. Жизневський В.М., Геменецький В.В. Промисловий каталіз у нафтопереробці та технології органічних продуктів. – Львів: Видавництво Львівської політехніки. 2010. 272 с.
 4. Григоров А.Б., Наглюк И.С. Рациональное использование моторных масел. – Х.: «Точка». 2013. 179 с.
 5. Методи визначення якості нафти та нафтопродуктів: навчальний посібник / А.Б. Григоров, І.В. Сінкевич, І.О. Лаврова, О.В. Богоявленська. – Х.: ФОП Панов А.М. 2016. 146 с.
 6. М. Братичак, О. Гринишин, Ю. присяжний, А. Пушак Нафтополімерні смоли із функційними групами. Синтез, властивості, застосування. – Львів: Видавництво Львівської політехніки. 2016. 164 с.
 7. Евдокимов А.Ю., Фукс И.Г., Любинин И.А. Смазочные материалы в техносфере и биосфере: экологический аспект. – К.: Атика-Н. 2012. 292 с.

LIST OF QUESTIONS FOR EXAM PREPARATION

The current state of oil and gas complexes in the world and Ukraine. Fuel resources and deposits of Ukraine. Dynamics of oil, gas and coal production in the world and in Ukraine. The main directions of improvement of technological processes at oil refineries. The process of slow coking in the schemes of refineries. Modern processes of visbreaking in the schemes of refineries. Modern processes that refine products and deepen oil refining. Innovative reagents and materials that stimulate the extraction, transport and processing of liquid and gaseous carbohydrates. Fundamentals of polymer production processes. Performance properties of macromolecular substances.

LIST OF EQUIPMENT

Scales electronic RADWAG (AS 220 / C); Scales analytical electronic ANG-2160C; stationary laboratory centrifuge CLE-3; Viscometer "Rheostat-2"; PH-meter-millivoltmeter ZR-121; Calorimeter for gaseous fuel "Junkers"; Colorimeter TA-1; Hydrogen converter; sulfur analyzer.

EVALUATION SYSTEM

Distribution of points for assessing the success of graduate students	The sum of points for all types of educational activities	Rating ECTS	Score on a national scale	Scoring
	90-100	A	Excellent	
	82-89	B	Good	
	74-81	C		
	64-73	D	satisfactorily	
60-63	E			

Points are accrued according to the following ratio:

- laboratory work: 20% of the semester grade;
- independent work: 20% of the semester grade;
- exam: 60% of the semester grade

	35-59	FX	unsatisfactory with the possibility of reassembly	
	0-34	F	unsatisfactory with mandatory re-study of disciplines	

STANDARDS OF ACADEMIC ETHICS

The graduate student must adhere to the "Code of Ethics of Academic Relations and Integrity of NTU" KhPI ": to show discipline, education, friendliness, honesty, responsibility. Conflict situations should be openly discussed in study groups with the teacher, and in case of conflict resolution should be reported to the staff of the graduate school department.

The syllabus in content fully corresponds to the work program of the discipline