Course PETROCHEMICALS PRODUCTION PROCESSES

Basic Information

This is a course, which contributes to MSc award in Petroleum Chemistry and Refining

Course period	From October 1st till February 28 th, 3 semester (15 weeks)
Study credits	7 ECTS credits
Duration	252 hours
Language of instruction	English
Academic requirements	– BSc degree in Petroleum Engineering, Engineering, Chemistry, Environmental Sciences or equivalent (transcript of records), – good command of English (certificate or other official document)

Course Description

Natural gas and crude distillates such as naphtha from petroleum refining are used as feedstocks to manufacture a wide variety of petrochemicals that are in turn used in the manufacture of consumer goods. “Petrochemicals production processes” provides students with knowledge and generates skill in the field of technologies for producing the most bulk groups of petrochemical products. The course acquaints students with petrochemicals laboratory synthesis, petrochemical process operations and basic technological equipment. Technical and economic indicators calculation of chemical-technological processes is also discussed.

Special Features of the Course

1. The course is split into 5 major sections: fundamentals of petrochemical production processes, aromatic hydrocarbons and derivatives, olefins chemistry and technology, monomers production and polymer chemistry, petrochemical industry overview.

In addition to conventional lectures the course offers a range of other learning opportunities in which students actively participate. Moreover, students will be involved in online mini-games and tests.

2. Provides broad technical information on petrochemical production processes, enabling a rapid immersion in the petrochemical field.

Detailed course material with a glossary of the main technical terms used in petrochemical industry. There are new trends in production technology, petrochemical application

characteristics to European and worldwide scale. Up to date petrochemicals production schemes are included.

Course Aims

- To provide the student systematic knowledge with the crucial aspects of petrochemical manufacture
- To improve and expand organic chemistry of compounds of petroleum and refining;
- To learn to realize petrochemical synthesis methods and laboratory synthesis.

Course Objectives

- To arrange general refinery and petrochemical operations, their products and economic importance.
- To promote an understanding of Individual process units covering separation, treatment and conversion of crude oil into refined hydrocarbon products.
- To examine petrochemicals extraction and refining methods, depending on their physical and chemical properties.
- To acquaint with the synthesis methods of some petrochemical products in the laboratory.

Learning Outcomes of the Course

By the end of the course, students will be able to:

- To describe raw materials and products types of petrochemical synthesis,
- To classify the main extraction and refining processes of petrochemical products,
- To illustrate basic schematic diagrams for producing the most bulk products of petrochemical synthesis,
- To select a laboratory glassware and equipment for the synthesis of some petrochemical products in the laboratory,
- To recognise basic technical and economic efficiency indicators of the chemical-technological process.

Course Outline

Week	Lectures	Practice session / Assignments	Hours[1]
1-3	1.Fundamentals of petrochemical production	Lecture 1. Structure of petrochemical complexes Lecture 2. Petrochemicals feedstock (natural gas, crude oil, oil shale, gas	2 2

[1] Hours designed for Classroom sessions, Web-sessions, Home Assignments etc.

	processes	hydrates) Practice sessions 1. Calculation of the composition of hydrocarbon mixtures (mass, mole fraction, volume ratio of a component in mixture) Practice sessions 2. Principles of compilation of material balances Practice sessions 3. Key indicators of petrochemical processes Practice sessions 4. Calculation of flow rate factors Home assignment No 1 Preparation of a laboratory reports 1,2	2 2 2 2
3-8	2. Chemicals based on aromatic hydrocarbons	Lecture 3. Chemicals based on Benzene (properties, production, application, processes) Lecture 4. Chemicals based on Toluene (properties, production, application, processes) Lecture 5. Chemicals based on Xylene (properties, production, application, processes) Practice sessions 5. Reactions of Benzene Practice sessions 6. Reactions of Toluene Practice sessions 7. Reactions of Xylene Practice sessions 8. Calculation of processes based of aromatic hydrocarbons Home assignment No 2 Preparation of a laboratory reports 3,4,5	2 2 2 2 2 2 4
9-12	Olefins chemistry and technology	Lecture 6. Chemicals based on Ethylene (properties, production,	2

		derivatives and application, reactions and processes) Lecture7. Chemicals based on Propylene (properties, production, derivatives and application, reactions and processes) Lecture 8. Synthesis of oxygenated products based on olefins (synthesis of alcohols, ethers, ethylene glycol, propylene glycol, acetic acid, methyl-tret-butyl-ether) Practice sessions 8. Reactions of Ethylene Practice sessions 9. Reactions of Propylene Practice sessions 9. Reactions for the production of oxygenates Practice sessions 10. Calculation of processes based of Olefins Home assignment No 3 Preparation of a laboratory reports 6,7,8	2 4 2 2 2 4
13	Monomers production and polymers chemistry and technology. State of petrochemical industry	Lecture 9. Polymer structure, properties and characterization Lecture 10. Polymerization chemistry (technological design of the polymerization process. Bulk polymerization.) **Practice sessions 10.** Polymerization reactions Home assignment No 4 Test: monomers and polymers	4 2 2

14	State of petrochemical industry	Lecture 11. Trends in the petrochemical industry. (the most bulk petrochemical products. Perspective directions of scientific research in the field of petrochemistry. Short overview of upcoming areas of scientific research in the field of petrochemistry) Practice sessions 11. Report of students on the topic Home assignment No 5	2 4
15	Final exam		2

Lecturer and Contact Information

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Assessment

Grade policy for both home assignments and the final exam is:

A (excellent work) 91–100 points

B (above average work) 81–90 points

C (average work) 71–80 points

D (below average work) 50–70 points

F (failed work) < 50 points

Students are assessed by results of practical laboratory work, tests, and a final exam. Progress assessment:

25% home assignments;

25% reports of the laboratory work;

25% intermediate quiz

25% written examination

Attendance Policy

Students are expected to attend and participate in classes and should notify trainers of excused absences in advance, where possible. Students who have an excused absence are expected to make arrangements with instructors for alternative assignment.

Every topic has a home assignment work that should be done. The final mark will be made by the same grade policy as for a final exam.

Web page of the course

The webpage of the course *Petrochemicals production processes* is available through E-learning SibFU web site: www.e.sfu-kras.ru . You must be logged in to access this course. Course materials and required reading materials are available at the course web-page.

Core reading

The main book for this course is Handbook of Petroleum Processing Steven A. Treese, Peter R. et al. It contains all information that is required for study in a more extensive manner. It will help students to reach a deeper understanding of petrochemicals technology.

The book Polymer Solids and Polymer Melts–Mechanical and Thermomechanical Properties of Polymers K. F. Arndt and M. D. Lechner. is also recommended for studying the basic petroleum and polymer chemistry that will be used during the course.

Books Polymer Science Dictionary by Mark Alger, Problems and Solutions in Oil Refining and Petrochemical Industry by Alec Groysman (Apart from Handbook of Petroleum Processing) will be extremely helpful in order to understand the intent of all petrochemicals production processes.