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	6 ECTS credits		
Duration	216 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

Today, polymeric materials are used in nearly all areas of daily life and their production and fabrication are major worldwide industries. The course acquaints students with the fundamentals of polymer technology and focuses on general understanding of polymers, polymer structure, major polymer types and common polymer additives/modifiers.

Alongside with the above, "Polymer technology" provides students with mechanical and thermal properties of polymers and its chemical resistance. The main polymers using areas (plastics, elastomers, laminates, gas-filled polymers, fibers, adhesives, paint and varnish materials, ion exchange resins) are characterized. Furthermore, the impact of each polymer production process on environmental regulations and pollution control is also discussed.

The most important part of this course is laboratory activity. Students will perform different laboratory experiments for given tasks to achieve a proper result.

Special Features of the Course

1. The course is split into 3 major sections: essentials of polymer technology, polymer industry and production, environmental problems of polymer production and environmental protection.

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 polymer production processes, enabling a rapid immersion in the polymer field.

Detailed course material with a glossary of the main technical terms used in polymer industry. There are new trends in production technology, polymers application characteristics to European and worldwide scale. Up to date petrochemicals production schemes are included.

3. Polymer chemistry laboratory activities

Range of experiments will be undertaken and its main objectives will be analyzed in the conclusion to determine whether the experiments succeeded.

Course Aim

The aim of this course is to provide students with an integrated view of polymer science and engineering, including the chemical structure of various polymers, methods of measuring the molecular weight, polymerization kinetics and reactors, rheological behavior, polymer processing technologies. The focus is mainly on processing of polymers as well as on the behaviour of different polymeric materials.

Course Objectives

- To analyze the basic chemistry of addition polymerization, and discuss a number of commercially important polymers produced by addition polymerization.
- To describe polymer classification, differentiate between condensation and additional polymerization
- To promote an understanding of polymers production consepts.
- To examine the broad polymer environment based on tests and laboratory experiments.
- To brief on polymer synthesis theory.
- To to review the design and manufacture of polymer products, with particular emphasis on material selection and processing technology.

Learning Outcomes of the Course

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

- To describe the general structure of polymers and practically perform different types of polymerizations,
- To illustrate how the polymers feedstock composition may affect on products output, from chemical point of view,
- To suggest measures to control the molecular weight and the rate of polymerization
- To experiment on bulk and emulsion polymerization and calculate molecular mass and sulfur content,

- To select and employ sophisticated synthesis techniques for analyzing the efficiencies
- of polymers usage in complex industrial processes,
- To recognise the impact of engineering solutions in a global and environmental context.

Course Outline

Week	Lectures	Practice session /	Hours ¹
		Assignments	
1	Essentials of polymer technology	 A brief overview of historical evolution of polymers, Polymers classification by chemical structure and synthesis method, General physical and mechanical properties of polymers. The main polymers using areas. 	2 2 4
		 Feedstock and products quality. International and Russian standards of quality. 	2
2	Essentials of polymer technology	 Feedstock in polymer production. Synthesis monomers from hydrocarbons. Alternative sources of hydrocarbon raw materials (gas, coal, slates, etc), Polymer synthesis theory: polymerization, polycondensation and modification mechanisms. Molecular structure of polymers and its other properties. 	2
3	Polymer industry and production of polymers	 Production technology, polymers application (and its properties) obtained by the polymerization reaction. Feedstock characteristics, synthesis of general polymers (polyethylene, polypropylene, polystyrene, polyacrylates) 	2 2
		 Production technology, polymers 	2

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

		 application (and its properties) obtained by the polycondensation reaction. Feedstock characteristics, synthesis of polymers (Phenol- and amino-aldehyde heterochain polyesters, polyepoxides, polyamides), Polymers obtained by chemical modification (polymeric alcohols, cellulose ethers). 	2
4	Environmental impacts of the petroleum refining industry	 Causes, Effects and Solutions to Environmental Pollution of polymer industry. Recycling of polymers Laboratory works Final test 	2 30 2
15	Final exam		2

Lecturer and Contact Information



Elena I. Lesik

Ph.D., Associated Professor at School of Petroleum and Natural Gas Engineering, Siberian Federal University (room 315) 82/6, Svobodny prospect, Krasnoyarsk, Russia Tel: +7 391 342-85-83, elesik@sfu-kras.ru

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Alexander E. Tretyakov

Senior lecturer at School of Petroleum and Natural Gas Engineering, Siberian Federal University (room 3323) 82/6, Svobodny prospect, Krasnoyarsk, Russia Tel: +7 965 896-01-50, aetretyakov@sfu-kras.ru

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

• To pass the exam students have to do all course's assignments The final exam consists of two parts: laboratory reports and writing exam.

- Students should be able to:
 - defend the laboratory reports (50 points maximum),

• write an answer on 2 questions, demonstrate covered material (50 points maximum).

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 <u>Polymer Technology</u> is available through E-learning SibFU web site: <u>www.e.sfu-kras.ru</u>. 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 <u>Polymer Solids and Polymer Melts–Mechanical and</u> <u>Thermomechanical Properties of Polymers</u> K. F. Arndt and M. D. Lechner. It contains all information that is required for study in a more extensive manner. It will help students to reach a deeper understanding of polymer technology. The book <u>Handbook of Petroleum Processing</u> Steven A. Treese, Peter R. et al is also recommended for studying the basic petroleum chemistry that will be used during the course.

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