Siberian Federal University

Research Seminar
Course (module) Title

Research Seminar
Course (module)

Krasnoyarsk, 2020
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Course (module) Guide Research Seminar

1. Course (module) Description

1.1 Course (module) overview

The course of «Petrochemicals production processes» provided a curriculum of postgraduate program 02.00.13 Petroleum Chemistry.

The purpose of studying the discipline Research Seminar is to form research skills among the students who have a high level of theoretical knowledge in the field of petrochemistry. The course helps to learn how to discuss publicly qualifying research work in all stages of implementation. These outstanding abilities are critical for scientific and pedagogical personnel with the highest qualification degree for feature activities on independent research conducting, teaching and expert consulting activities.

1.2 Special features of the course (module)

- The course acquaints with the main theoretical schools, approaches, concepts in petrochemistry.
- The course helps to determine cutting-edge research areas for the topic selection by the graduate student.
- The course creates abilities to search, analyze, understand and generalize scientific and technical information critically by graduate students, formalize the results of research work.
- The course up scales the professional level of the postgraduate students for being capable to solve the main problems of modern petrochemical sciences.
- The course forms professional skills in the organization of research work, including the goals and objectives of the research, preparation of a research program, experiments and tests, processing, analysis and publications of the results of scientific work.
- The course provides an experience in public presentation and scientific discussion.

1.3 Course (module) aim

- To provide the postgraduate student systematic knowledge with the crucial aspects of petrochemical manufacture.
- To improve abilities of scientific presentation and scientific results
publication.
- To improve and expand knowledge in organic chemistry of compounds of petroleum and refining.
- To learn to realize petrochemical synthesis methods and laboratory synthesis.

1.4 Course (module) objectives

- To arrange knowledge in 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.

1.5 Learning outcomes of the course (module)

By the end of the course, students will be able to:
- carry out research activities independently in the relevant professional field using modern research methods, information and communication technologies;
- organize the work of a research team in the field of chemistry and related sciences.

A graduate of postgraduate course must have the following professional competencies:
- the ability to conduct independently scientific research with obtaining scientific results that meet the established requirements for the content of dissertations for the degree of sciences candidate in the scientific specialty Petrochemistry;
- the ability to realize teaching activities in the field of petrochemistry.

1.6 Teaching and Learning Methods

The course includes methodological information which will be educated by the students themselves, practice sessions and seminars session in lecture halls of «Basic chair of chemistry and technology of natural energy
2. **Course Instructor(s) and Tutor(s), Contact Information**

**Sergei V. Kudryashev**, Head of the program

Doctor of Chemistry in specialty 02.00.13 Petroleum Chemistry, Deputy Director for Science at the Institute of Petroleum Chemistry, Siberian Branch of the Russian Academy of Sciences, Professor

Research fields: plasma-chemical transformations of hydrocarbons.

**Address**: (room 313) 82/6, Svobodny prospect, Krasnoyarsk.

**E-mail**: fburyukin@sfu-kras.ru

3. **Prerequisites**

Background in general chemistry, organic chemistry, refining.

4. **Course (module) Outline**

4.1 **Course (module) requirements**

4.1.1. **Required text(s)**

**Main literature**


Additional literature


3. Polymers from Pristine and Modified Natural Monomers. Chemicals & Fuels


The list of information and telecommunication resources required for mastering the discipline (module) is available via Internet network

3. www.nature.com - Scientific journal Nature. The access mode is free.
5. www.springerlink.co - Springer Database.
6. www.isiknowledge.com - Web of Science Database. Access mode is free.

4.1.2 Web page of the course (module)

You can receive the information about the postgraduate program 02.00.13 Petroleum Chemistry and about the course in SibU website: 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.

4.1.3. Course (module) materials (seminar notes, assignments for classroom activities and sessions)

Prior to attending the seminars some preparation can be very valuable. Consultation on the Research Seminar module is carried out by electronic
resources that are associated with the SFU or face-to-face. There are various materials for self-preparation, for seminars or practical classes, which are available a week before the class on the web page of the discipline provided by My SFU Resource. The materials can be in form of simple text documents while others may be audio or video files, or online exercises. Most of them are supplementary intended for independent study and are not supposed to replace the practical sessions. The great benefit is that you can return and revisit them when you want. Home assignments involve printed reports, oral or visual presentations.

**4.1.4 Required feedbacks**

The supervisor might use the web page of the discipline as a communication channel. It is important that you become familiar with checking and accessing it regularly. Make sure that you have access to the correct module pages, and get in touch with your lector or programmer administrators in any other cases.

**4.2. Course (module) Structure**

**4.2.1 Internal education**

<table>
<thead>
<tr>
<th>Learning activities</th>
<th>Total credits (academic hours)</th>
<th>Semester</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>6 cr. (216 a. h.)</td>
<td>3 cr. (108 a. h.)</td>
<td>3 cr. (108 a. h.)</td>
</tr>
<tr>
<td>Lectures</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Practice sessions / Seminars,</td>
<td>1,39 cr. (50 a. h.)</td>
<td>0,72 cr. (26 a. h.)</td>
<td>0,67 cr. (24 a. h.)</td>
</tr>
<tr>
<td>Self-study of the students:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study of the theoretical course (including preparation for final attestation)</td>
<td>4,61 cr. (166 a. h.)</td>
<td>2,28 cr. (82 a. h.)</td>
<td>2,33 cr. (84 a. h.)</td>
</tr>
<tr>
<td>Final Attestation</td>
<td>credit, credit</td>
<td>credit</td>
<td>credit</td>
</tr>
</tbody>
</table>
### 4.3 Time schedule course (module) and course (module) outline

#### 4.3.1 Internal education

<table>
<thead>
<tr>
<th>№</th>
<th>Topic</th>
<th>week, №</th>
<th>Learning Activities (lecture, lab, class assignments, assessment and other)</th>
<th>Hours</th>
<th>Self-study Assignments</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Analysis of current research areas on the topic of the dissertation.</td>
<td>1-5</td>
<td><strong>Seminar 1.</strong> Goals and objectives of the thesis. Analytical review of scientific publications and patents on a given topic. Methods for finding scientific information. Critical analysis of information.</td>
<td>16</td>
<td></td>
<td>The literature listed in 4.1 paragraph. The articles and materials are indexed by Scientific Databases listed in 4.1 paragraph.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-10</td>
<td><strong>Seminar 2.</strong> Formulation of the thesis topic, justification of the topic relevance. Formation of the goals and objectives of the research. Preparation of a report for the scientific seminar.</td>
<td>7</td>
<td>Exact topics for assignments are depended on the line of academicals research that is conducted by the students. They must prepare not less than 3 oral/writing reports</td>
<td>The literature listed in 4.1 paragraph. The articles and materials are indexed by Scientific Databases listed in 4.1 paragraph.</td>
</tr>
<tr>
<td>2</td>
<td>Drawing up of a research program and a plan of the dissertation</td>
<td>11-17</td>
<td><strong>Seminar 3.</strong> Analytical selection of research methods, justification of the instruments and equipment that are planning to be used. Drawing up a research plan. Scientific report preparation, scientific seminars</td>
<td>9</td>
<td>Exact topics for assignments are depended on the line of academicals research that is conducted by the students. They must prepare not less than 2 oral/writing reports</td>
<td>The literature listed in 4.1 paragraph. The articles and materials are indexed by Scientific Databases</td>
</tr>
</tbody>
</table>

1* Semester
<table>
<thead>
<tr>
<th>Week</th>
<th>Course</th>
<th>1st Semester</th>
<th>2nd Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Final attestation</td>
<td>18</td>
<td><strong>Credit 1</strong></td>
</tr>
<tr>
<td>4</td>
<td>Drawing up of a research program and a plan of the dissertation</td>
<td>1-5</td>
<td><strong>Seminar 4.</strong> Analysis of the research work results. Overview of the programs that are used for experimental data processing.</td>
</tr>
<tr>
<td>5</td>
<td>Scientific research carrying out Analysis, processing and presentation of research results.</td>
<td>6-10</td>
<td><strong>Seminar 5.</strong> Structuring of materials comprise the dissertation. Basic rules for registration. Drawing up of presentations, scientific articles, reports</td>
</tr>
<tr>
<td>6-17</td>
<td><strong>Seminar 6.</strong> Interpretation of the research results. Preparing a report for the dissertation defense.</td>
<td>7</td>
<td>Exact topics for assignments are depended on the line of academicals research that is conducted by the students. They must prepare not less than 2 oral/writing reports about the programs that are used for experimental data processing.</td>
</tr>
</tbody>
</table>
5. Assessment

5.1 Form of assessment

Home assignment will involve some form of printed and oral reports, or downloadable file on the web page of the discipline within the specified period. The students must realize successfully not less than 6 oral reports during the course.

5.2 Grading scale

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% oral presentations;
- 25% writing presentation;
- 25% credits.

6. Attendance Policy

Students are expected to attend and participate in classes and should notify lecturer of excused absences in advance, where possible. Students who have an excused absence are expected to make arrangements with lecturer 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.
7. **Required Course (module) Participation**

Students should be able to:
• defend the writing reports (50 points maximum),
• write an answer on 2 questions, demonstrate covered material (50 points maximum).

8. **Facilities, Equipment and Software**

The implementation of the course provides for the availability of lecture rooms (personal computers, printers, copier, projector, demonstration materials) with access to webpages of the E-learning SibFU through web site: www.sfu-kras.ru. The training process for this course uses standard Microsoft Office programs.

List of required software.
1. Windows XP or later operating system from Microsoft® Windows family.
6. AutoCAD, free software.
Annex 1. Example of Questions for the Attestation

Questions for certification in the discipline "Research Seminar" are compiled individually for each student based on the topic of scientific research.
Annex 2. Example of Self-Study Assignment

Purpose of visbreaking

VR
1,000 to 3,000 cSt at 100°C

HFO
40 cSt maxi at 100°C

Diluent
gas oil 1 cSt at 100°C

- Need of a diluent to decrease the viscosity of vacuum residue
- Valorization of a fluxant at the price of a final product (heavy fuel)

Production of the heavy fuel depends:
- On the quality of the crude and on the yield of vacuum residue
- On the required quantity of fluxant

Is the refinery able to sell all the production of such a fuel???
If not the solution may be the VISBREAKING

100 TONS
VACUUM RESIDUE
2,000 cSt at 100°C

VISBREAKER

95.5 tons gas oil vacuum distillate residue 100 cSt at 100 °C

53 tons diluent (gas oil type) 1 cSt at 100°C

153 tons HFO n°2 40 cSt at 100°C

124.5 tons HFO n°2 40 cSt at 10°C

4.5 tons gas + gasolines

Advantages of VISBREAKER:
- decrease of heavy fuel production
- increase of gas oil production

Material balance made with 100 tons of vacuum residue

29 tons diluent (gas oil type) 1 cSt at 100°C
Crudes properties and comparison

Structural characteristics of petroleum fractions

Crudes properties and comparison

Typical distribution of Sulfur Compounds
Visbreaking feedstocks

Some of their properties are given in the table:

<table>
<thead>
<tr>
<th></th>
<th>Paraffinic</th>
<th>Naphtenic</th>
<th>Aromatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPECIFIC GRAVITY</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>(C/H) Mass ratio</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
</tr>
<tr>
<td>Net Calorific Value</td>
<td>High</td>
<td>Average</td>
<td>Low</td>
</tr>
</tbody>
</table>

Residue structure

- Residue feed structure is a colloidal system phase with:
  - A dispersed phase: micelles made of asphaltene and maltenes as heavy aromatics type (resins) adsorbed on asphaltene
  - A continuous phase: made of other maltenes
Soaker visbreaker
Course Research Seminar

Basic Information

This is a course, which contributes to postgraduate educational program 04.06.01 Chemical Sciences, specialization is 02.00.13 Petroleum Chemistry.

<table>
<thead>
<tr>
<th>Course period</th>
<th>From September 1st till May 31st, 3 and 4 semesters (30 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study credits</td>
<td>6 ECTS credits</td>
</tr>
<tr>
<td>Duration</td>
<td>216 hours</td>
</tr>
<tr>
<td>Language of instruction</td>
<td>English</td>
</tr>
</tbody>
</table>
| Academic requirements | – M. Sc degree in Petroleum Engineering, Engineering, Chemistry, Environmental Sciences or equivalent (transcript of records),  
|                      | – good command of English (certificate or other official document) |

Course Description

The purpose of studying the discipline Research Seminar is to form research skills among the students who have a high level of theoretical knowledge in the field of petrochemistry. The course helps to learn how to discuss publicly qualifying research work in all stages of implementation. These outstanding abilities are critical for scientific and pedagogical personnel with the highest qualification degree for feature activities on independent research conducting, teaching and expert consulting activities.

Special Features of the Course

- The course acquaints with the main theoretical schools, approaches, concepts in petrochemistry.
- The course helps to determine cutting-edge research areas for the topic selection by the graduate student.
- The course creates abilities to search, analyze, understand and generalize scientific and technical information critically by graduate students, formalize the results of research work.

- The course up scales the professional level of the postgraduate students for being capable to solve the main problems of modern petrochemical sciences.

- The course forms professional skills in the organization of research work, including the goals and objectives of the research, preparation of a research program, experiments and tests, processing, analysis and publications of the results of scientific work.

- The course provides an experience in public presentation and scientific discussion.

Course Aims

• To provide the postgraduate student systematic knowledge with the crucial aspects of petrochemical manufacture.
• To improve abilities of scientific presentation and scientific results publication.
• To improve and expand knowledge in organic chemistry of compounds of petroleum and refining.
• To learn to realize petrochemical synthesis methods and laboratory synthesis.

Course Objectives

• To arrange knowledge in 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:

- carry out research activities independently in the relevant professional field using modern research methods, information and communication technologies;
- organize the work of a research team in the field of chemistry and related sciences.

A graduate of postgraduate course must have the following professional competencies:

- the ability to conduct independently scientific research with obtaining scientific results that meet the established requirements for the content of dissertations for the degree of sciences candidate in the scientific specialty Petrochemistry;
- the ability to realize teaching activities in the field of petrochemistry.

Course Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Lections / Practice session / Assignments</th>
<th>Hours1 (Internal education)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-7</td>
<td>Analysis of current research areas on the topic of the dissertation.</td>
<td><strong>Seminar 1.</strong> Goals and objectives of the thesis. Analytical review of scientific publications and patents on a given topic. Methods for finding scientific information. Critical analysis of information. <strong>Seminar 2.</strong> Formulation of the thesis topic, justification of the topic relevance. Formation of the goals and objectives of the research. Preparation of a report for the scientific seminar. <strong>Self-study assignments.</strong> Exact topics for self-study assignments are depended on the line of academicals research that is conducted by the students.</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>55.33</td>
</tr>
</tbody>
</table>

1 Hours designed for Classroom sessions, Web-sessions, Home Assignments etc.
<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Details</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-14</td>
<td>Drawing up of a research program and a plan of the dissertation</td>
<td><strong>Seminar 3.</strong> Analytical selection of research methods, justification of the instruments and equipment that are planning to be used. Drawing up a research plan. Scientific report preparation, scientific seminars <strong>Self-study assignments.</strong> Exact topics for self-study assignments are depended on the line of academicals research that is conducted by the students.</td>
<td>9</td>
</tr>
<tr>
<td>15</td>
<td>Final attestation (Credit 1)</td>
<td></td>
<td>26.66</td>
</tr>
<tr>
<td>16-20</td>
<td>Drawing up of a research program and a plan of the dissertation</td>
<td><strong>Seminar 4.</strong> Analysis of the research work results. Overview of the programs that are used for experimental data processing. <strong>Self-study assignments.</strong> Exact topics for self-study assignments are depended on the line of academicals research that is conducted by the students.</td>
<td>5</td>
</tr>
<tr>
<td>21-29</td>
<td>Scientific research carrying out Analysis, processing and presentation of research results.</td>
<td><strong>Seminar 5.</strong> Structuring of materials comprise the dissertation. Basic rules for registration. Drawing up of presentations, scientific articles, reports <strong>Self-study assignments.</strong> Exact topics for self-study assignments are depended on the line of academicals research that is conducted by the students.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Seminar 6.</strong> Interpretation of the research results Preparing a report for the dissertation defense. <strong>Self-study assignments.</strong> Exact topics for self-study assignments are depended on the line of academicals research that is conducted by the students.</td>
<td>7</td>
</tr>
<tr>
<td>30</td>
<td>Final attestation (Credit 2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lecturer and Contact Information

Sergei V. Kudryashev, Head of the program

Doctor of Chemistry in specialty 02.00.13 Petroleum Chemistry, Deputy Director for Science at the Institute of Petroleum Chemistry, Siberian Branch of the Russian Academy of Sciences, Professor

Research fields: plasma-chemical transformations of hydrocarbons.

Address: (room 313) 82/6, Svobodny prospect, Krasnoyarsk.

E-mail: fburyukin@sfu-kras.ru

Assessment

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**Core reading**
