

ENSURING QUALITY AND RELIABILITY OF TECHNOLOGICAL EQUIPMENT

Basic Information

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

Title of the Academic Program	Master's Degree Programs in English “in Petroleum Chemistry and Refining”
Type of the course	Core course
Course period	1 st and 2 nd semester (32 weeks)
Study credits	7 ECTS credits
Duration	252 hours
Language of instruction	English
Academic requirements	<ul style="list-style-type: none">– 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

The course is developed with a focus on quality management, reliability control and safety ensuring of oil and natural gas processing equipment. It is designed for those seeking deeper and more specialist knowledge of methods, techniques and approaches used for assessment, management and ensuring equipment quality and reliability. In addition to a sound understanding of modeling complex technological systems reliability and quality, the course aims to develop skills necessary to ensure reliable and high-quality operation of the technological equipment of the oil and natural gas industry in general and refining in particular.

This course introduces students to methods used for quality and reliability evaluation and management, modern approaches including methods of system analysis, expert approach and risk management are also covered on the course. It places an emphasis on modern concepts and principles in the field of quality ensuring and considerable attention is paid to TQM and modern ISO standards in the field of quality.

Special Features of the Course

The course concentrates on the latest methods of quality, reliability and safety modeling and management. An essential distinctive course feature is the integration of system analysis methods and techniques for equipment and technological processes

Ensuring quality and reliability of technological equipment

quality and reliability assurance. Practical prominence is given to the analysis of modern technological systems with intelligent program control as complex man-machine systems is also a distinguishing feature of this course.

Course Aim

The course aims at developing students' skills in production management in the field of oil refining with regard to special aspects of technological processes.

Course Objectives

The course objectives are:

- to acquaint students with the basic principles of the quality and reliability examination of technological equipment used in oil and natural gas production and processing;
- to develop skills for designing solutions and decision support in the field of ensuring the quality and reliability of production equipment;
- to train skills required for evaluation of equipment quality and reliability indicators and application of modern techniques to achieve required quality levels and ensure the safety of technological processes.

Learning Outcomes of the Course

Students who complete the course will be able:

- to develop technological methods to ensure the reliability of equipment during operation;
- to perform effective quality control of technological processes and technological equipment;
- to analyze the reliability and safety of man-machine systems in gas-oil processing;
- to choose methods to ensure manufacturability and competitiveness of equipment;
- to employ modern methods of technological processes control to ensure a quality of equipment;
- to identify and analyze the causes of failure of machinery and equipment;
- to predict and diagnose state of machines and equipment;
- to evaluate reliability and residual service life of equipment;
- to use statistical methods of quality control.

Teaching and Learning Methods

Many topics are based around case studies, group discussions, as well as creative tasks and information and multimedia technologies.

The method of case studies is the basic one in the system of interactive methods of teaching the discipline. The analysis of specific situations (case studies) is designed to improve skills and gain experience in such areas as:

- problem identification and solving;
- information processing;
- analysis and synthesis of information and arguments;
- evaluation of alternatives;
- making decisions;
- group work skills.

Students of the master's degree are to reproduce the information received earlier in the form determined by the course instructor and requires a creative approach: a selection of examples from practice; a selection of material on a specific issue, etc.

Information and multimedia technologies, as a combination of methods and means of collecting, storing, processing, transferring and presenting information, are used in organizing practical (seminar) classes.

Course Structure

Learning Activities	Hours		
	1 st Semester	2 nd Semester	Total
Lectures	14	14	28
Practice sessions / Seminars,	14	14	28
Self-study Assignments	44	116	160
Final Exam (including preparation)	-	36	36
Total study hours	72	180	252

Course (module) Outline

Week, №	Lectures	Practice sessions	Assignments	Hours
1st Semester				
Topic 1 «Introduction. Quality and reliability assurance»				
1-2	Lecture 1 «Evolution of quality and reliability management»	Practice Session 1 « International standards of quality management: 9000 series, 14000 series, 18000»	Entry test (Test 1) Control questions 1 Preparation of the report on the practical assignment #1 «Finding changes in quality standards»	Lecture 2 Practice 2 Self-study 5
3-4	Lecture 2 «TQM. PDCA. Deming's principles. Standard ISO/TS 29001:2010»	Practice Session 2 «Key clauses of 'oil and natural gas industry standard ISO/TS 29001:2010»	Test 2 Crossword 1 Control questions 2 Preparation of the report on the practical assignment #2 «Analysis of oil and natural gas industry standard ISO/TS 29001:2010»	Lecture 2 Practice 2 Self-study 5
Topic 2 «Quality evaluation»				
5-6	Lecture 3 «Quality indicators evaluation»	Practice Session 3 «Complex and integrated quality indicators»	Test 3 Control questions 3 Completion of calculations and preparation of a report on the practical assignment #3 «Complex and integrated quality indicators evaluation»	Lecture 2 Practice 2 Self-study 5
7-8	Lecture 4 «Statistical methods of quality control»	Practice Session 4 «Application of basic statistical quality management techniques»	Test 4 Crossword 2 Control questions 4 Completion of calculations and preparation of a report on the practical assignment #4 «Application of basic statistical quality management techniques»	Lecture 2 Practice 2 Self-study 5

9-10	Lecture 5 «Expert approach in quality and reliability management»	Practice Session 5 «Application of Delphi expert approach»	Test 5 Control questions 5 Completion of calculations and preparation of a report on the practical assignment #5 «Application of Delphi expert approach»	Lecture 2 Practice 2 Self-study 5
Topic 3 «Reliability analysis in quality management»				
11-12	Lecture 6 «Basics of machinery reliability analysis»	Practice Session 6 «Calculation of reliability indicators»	Test 6 Crossword 3 Control questions 6 Completion of calculations and preparation of a report on the practical assignment #6 «Calculation of reliability indicators»	Lecture 2 Practice 2 Self-study 5
13-14	Lecture 7 «Probability distributions in reliability analysis»	Practice Session 7 «Processing of reliability data»	Test 7 Control questions 7 Completion of calculations and preparation of a report on the practical assignment #7 «Processing of reliability data»	Lecture 2 Practice 2 Self-study 5
Semester credit				
15-16	Final practice report			Self-study 9
2nd Semester				
Topic 4 «Quality management techniques»				
1-2	Lecture 8 «Techniques for complex production systems reliability and quality analysis»	Practice Session 8 «FTA and decision trees in reliability analysis»	Test 8 Control questions 8 Completion and preparation of a report on the practical assignment 8 «FTA and decision trees in reliability analysis»	Lecture 2 Practice 2 Self-study 14

3-4	Lecture 9 «Six sigma approach»	Practice Session 9 «Application of six sigma approach»	Test 9 Control questions 9 Completion and preparation of a report on the practical assignment 9 «Application of six sigma approach»	Lecture 2 Practice 2 Self-study 14
5-6	Lecture 10 «Quick Response Quality Control (QRQC)»	Practice Session 10 «QRQC for real refinery production system»	Test 10 Control questions 10 Completion and preparation of a report on the practical assignment 10 «QRQC for real refinery production system»	Lecture 2 Practice 2 Self-study 14
7-8	Lecture 11 «Failure Mode and effect Analysis (FMEA)»	Practice Session 11 «Application of FMEA»	Test 11 Control questions 11 Completion and preparation of a report on the practical assignment 11 « Application of FMEA for real refinery production system»	Lecture 2 Practice 2 Self-study 14
Topic 5 «Human reliability»				
9-10	Lecture 12 «Factors of human reliability»	Practice Session 12 «Exploration of human reliability factors for refinery stuff»	Test 12 Crossword 4 Control questions 12 Completion and preparation of a report on the practical assignment 12 « Exploration of human reliability factors for refinery stuff »	Lecture 2 Practice 2 Self-study 14
11-12	Lecture 13 «Techniques for human reliability analysis»	Practice Session 13 «Application of techniques for human reliability analysis»	Test 13 Control questions 13 Completion and preparation of a report on the practical assignment 13 « Application of techniques for human reliability analysis»	Lecture 2 Practice 2 Self-study 14

Topic 6 «Quality and reliability cost»				
13-14	Lecture 14 «Concepts of quality and reliability cost»	Practice Session 14 «Estimation of quality and reliability costs in oil and gas processing»	Test 14 Control questions 14 Completion and preparation of a report on the practical assignment 14 «Estimation of quality and reliability costs in oil and gas processing»	Lecture 2 Practice 2 Self-study 14
	Final practice report			Self-study 16
16	Final Exam			36

Course Instructor(s) and Tutor(s), Contact information



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Assessment

During the course, a student recruits points for participation in classes. The maximum number of points is 1000 points. This amount consists of the following components:

1. Attending and participation in class.
2. The course includes 14 tests (1 for each topic).
3. The course includes 4 crossword puzzles
4. The course includes 14 practice assignments.
5. The course includes the exam.

Thus, the maximum score for all five points is: $20 + 420 + 40 + 420 + 100 = 1000$ points.

The estimate for the course is then recalculated according to the following scale:

- A (excellent work) 901-1000 points
- B (above average work) 801-900 points
- C (average work) 701-800 points

- D (below average work) 501-700 points
- F (failed work) <500 points

Attendance Policy

Attending all lectures and lab sessions is mandatory and participation in class is strongly encouraged. There will be no make-up sessions if you miss a lecture or lab. In case of an emergency, please notify the instructor in advance.

Web page of the course

The webpage of the course Ensuring quality and reliability of technological equipment - <https://e.sfu-kras.ru/enrol/index.php?id=10954> is available through E-learning SFU web site: www.e.sfu-kras.ru. You must be logged in to access this course. Course Guide and all accompanying materials are also available at the course web-page.

Core reading

The following is a list of books that might be useful to refer to once in a while during the course. However, complete course material will be provided by the instructor in the form of slides, summaries, tutorials, hand-outs etc.

1. Birolini A. Reliability Engineering. Theory and Practice : with 140 Figures, 60 Tables, 120 Examples, and 50 Problems/A. Birolini. – 2007 (SFU Library)
2. Smith D. J. Reliability, maintainability and risk: practical methods for engineers/D. J. Smith. – 2001 (SFU Library)
3. Hoyle D. ISO 9000 quality systems handbook / D. Hoyle. – 2001 (SFU Library)
4. Hoyle D. ISO 9000 quality systems handbook / D. Hoyle. – 2009
5. Calixto E. Gas and oil reliability engineering: modeling and analysis. – Gulf Professional Publishing, 2016.
6. Sutton I. Process risk and reliability management. – Gulf Professional Publishing, 2014.
7. Rausand M. et al. System reliability theory: models, statistical methods, and applications. – John Wiley & Sons, 2004.
8. Ross J. E., Perry S. Total quality management: Text, cases, and readings. – CRC Press, 1999.
9. Dillon B. S. Design Reliability: Fundamentals and applications. – CRC Press Boca Raton New York Library of congress, 1999.
10. Groysman Corrosion Problems and Solutions in Oil Refining and Petrochemical Industry/Alec Groysman. – 2017

Recommendations for adding other good references to the above list are highly welcome. Please let the instructor know if you have found some reference material to be particularly useful and instructive.

Facilities, Equipment and Software

Facilities

Each student during the entire period of education is provided with individual unlimited access to electronic library systems (electronic libraries) and to the electronic information and educational environment of the University. The electronic library system (electronic library) and the electronic information and educational environment provide the possibility of access from any point where there is access to the Internet and meet the technical requirements of the organization either on the territory of the University or outside.

The electronic information and educational environment of the University provides:

- access to curricula, working programs of disciplines (modules), practices, publications and electronic educational resources specified in work programs;
- progress of the educational process, the results of intermediate certification and the results of mastering the basic educational program;
- all types of learning materials, forms for learning outcomes evaluation with the use of e-learning, distance educational technologies;
- an electronic portfolio of the student, including student's reports, reviews and evaluations repository;
- interaction between participants in the educational process, including synchronous and (or) asynchronous interaction via the Internet.

Equipment

The implementation of the program provides facilities for performing classes of all types, group and individual consultations, monitoring and intermediate evaluation, as well as accommodation for independent work and facilities for storage and preventive maintenance of equipment. The auditoriums are equipped with specialized furniture and technical tools, used to present information.

Software

The educational process for this discipline uses standard Microsoft Office software.