Уральский федеральный университет
имени первого Президента России Б.Н. Ельцина

MASTER PROGRAMME
Technologies of water resources management: Water discharge and wastewater treatment

DEVELOPED IN THE FRAMEWORK OF THE
TEMPUS PROJECT 159311- TEMPUS-1-2009-IT-JPCR "NETWORK FOR MASTER TRAINING IN TECHNOLOGIES OF WATER RESOURCES MANAGEMENT - NETWATER"

PROGRAMME HANDBOOK

in cooperation with
University of Genoa, Italy
Middlesex University of London, UK
Slovak University of Technology, Bratislava
Tambov State Technical University, Russia
Vladimir State University, Russia
Bauman Moscow State Technical University, Russia

European Commission
TEMPUS

Ural Federal University
2011

University	**Ural Federal University, Russia**
Programme level	**Master level**
Status	**Joint International Programme**
Name of the course	**Water discharge and wastewater treatment**
Field and classification code	**Construction Engineering** **270100 (Russian education classification code)**
Qualification	**Master of Engineering and Technology**
Web-site	**Website http://www.ustu.ru/home/faculties/stf/dep-st/vhtv/magistracy-270100/**
Faculty	**Institute of Construction Engineering**
Address	**Ural Federal University, Institute of Construction Engineering, Department of Water Industry and Technology, 17 Mira street, 620002, Yekaterinburg**
Course length	**2 years**
Workload	**According to ECTS - 120 credits (Russian education standard – 4320 academic hours)**
Start date	**October 2010**
Professional recognition	**The following stakeholders have been consulted for the designing of the Course programme:** **Municipal Unitary Enterprise "Vodokanal", "Russian Research Institute of Water Economy", "ECO-PROJECT", Federal Service for Oversight of Consumer Protection and Welfare in the Sverdlovsk region. Ministry of Education and Science of RF, Education and Methodological Association on Engineering specialities**
Teaching organization	**Semester modules, front lessons, field trips, laboratory works, individual work, scientific supervising, master thesis preparation**

Preliminary statement: The students' workload in the Russian Federation is calculated in academic hours. An academic hour means 45 minutes according to the regulations for higher education. When the Russian Federation entered Bologna process some measures were carried out to harmonize academic systems.
The Russian Ministry of Education suggested a methodology to be used for introduction ECTsystem to Russian universities.
The term "Zachetnaya edinitsa" (approximate translation is "passing unit") was introduced. We could call it here "Russian credit unit (RCU)" and consider 1 RCU = 1 ECTs credit unit.
According to the methodology suggested by the Russian Ministry of Education:
1 Russian credit unit (RCU) = 36 academic hours
1 academic week =54 ac.hours = 1,5 RCU
Discipline workload is calculated by dividing academic hours by 36
1 practice week = 1,5 RCU
1 exam = 1 RCU

Aims of the programme:
The main aim of the programme is to provide research and technological knowledge in the sphere of use, technological treatment and technological management of water resources. Master course is targeted at training specialists with deep knowledge in the field of traditional ways of water treatment and innovation membrane technologies that may be used for improving the

quality of water resources. Graduates obtain professional competences in the field of sustainable development of water resources and water treatment for domestic, industrial and agricultural use and processing regardless of the initial characteristics of the source. Special emphasis is made on water discharge and wastewater treatment for industrial enterprises.
Master programme is oriented at labour market demands under the conditions of restructuring of water resources complex, water resources shortage, modernization of the spheres of housing and utility services and industry.
Curriculum is developed on the basis of generalized scientific and technical knowledge and applied aspects of innovation research. The Master course is targeted at strengthening the link between education and professional skills required by labour market. Credit system will be based on academic courses, practical classes and laboratory works.

Programme languages: Russian and English

Admission criteria:

- **Bachelor or Specialist degree in** a relevant branch of science or engineering; work experience in the field is appreciated.
- **Entrance examination - oral interview**
- Overseas candidates are required to have the certificate of Russian language course attendance.

Teaching methods

Lectures, seminars, research supervision, practical sessions, workshops, supervision of individual work of students, problem solution classes, laboratory works, internships, mobilities, field practice, e-learning.

Facilities

- Modern lecture halls, computer-equipped rooms, software means, multimedia equipment are used for implementing the programme
- Research is carried out on the base of two department-owned laboratories and on the technological base provided by employers: Municipal Unitary Enterprise "Vodokanal", "Russian Research Institute of Water Economy", "ECO-PROJECT", accredited laboratories of Federal Service for Oversight of Consumer Protection and Welfare in the Sverdlovsk region.
- For their laboratory and research works students have access to 6 stand units for studying physical and chemical processes of water treatment (sorption, ion exchange, coagulation, ozonation, chemisorptions, magnetic treatment, membrane separation, ultra nanofiltration, filter regeneration, wastewater sludges dewatering).
- Study of membrane processes and processes of membrane separation is carried out on industrial pilot plant purchased within the frames of TEMPUS NETWATER project

Within the frames of the programme Master students will obtain the following competences:

Students will obtain strategic, managerial and technical skills necessary to carry out professional activities in the sphere of water management. The will become familiar with all aspects of integrated water resource management and will have in-depth knowledge of wastewater

treatment processes, management of technological processes, membrane separation processes; be capable of carrying out experiments for data obtaining, making statistical and critical analysis. Students will obtain practical skills of water treatment for different purposes. They will recognize the social and economic factors impacting effective water solutions, understand social responsibility of carrying out research and practical works in the field of water resources management. The programme allows to develop the skills in such fields as critical solving, decision-making, data and project management, teach work, knowledge transfer, IT technologies application, research ethics, presentation.

Programme structure

Compulsory subjects

- Membranes and Membrane processes
- Water engineering
- Water ecology and human impact
- Monitoring and analytical control of water
- Water and wastewater treatment
- English language
- Contemporary Research and Technological Problems in the field of Construction Engineering (with a focus on environmental protection)
- Research History and Methodology in Environment Protection
- Computer Technologies in Research and Education
- Industrial application case study

Elective subjects

- Processes and apparatus of wastewater and sludges treatment
- Ecological expertise and control
- Experimental studies of wastewater treatment

Programme Outcomes

A. Knowledge and understanding A1: In-depth knowledge of theoretical foundations of waste-water processes A2: Understanding of criteria for selecting technological water and wastewater treatment processes A3 : Understanding of the principles of managing and improving technological processes A4: In-depth knowledge of membrane technologies A5: In-depth knowledge of experimental methods of data obtaining A6: Understanding of statistical methods of data analysis A7: Evaluation and critical analysis A8: Understanding the socio-economic factors impacting effective water solutions A9: Understanding of the governance and institutional frameworks underpinning water resource management	**Teaching/learning methods** Students gain knowledge and understanding through attendance in lectures, seminars and laboratories. Besides a variety of learning activities is conducted, such as: group projects, case study analysis, field trips, student presentations. Electronic resources will be used to enhance student learning experiences. Students will be directed to explore a wide range of various learning materials, such as books, journals, patents, as well as electronic sources and web links. **Assessment method** Students' knowledge and understanding is assessed by a variety of methods such as examinations, tests, laboratory reports, case study analysis and student presentations.
B. Practical skills B1: Practical skills in domestic water supply and wastewater treatment B2: Practical skills in industrial water supply and wastewater treatment B3: Skills of selecting and using and use appropriate methods and technologies for water use, reuse, recycling and purification B4: Conduct laboratory and field experiments, collect, analyse and interpret data B5: Use appropriate information technologies for professional and management purposes	**Teaching/learning methods** Students learn cognitive skills through attending seminars and implementing laboratory projects, doing group and mini group projects, case study analysis, field trips, student presentations. Electronic resources will also be used to enhance student cognitive skills. **Assessment method** Students' cognitive skills are assessed by a variety of methods such as examinations, tests, laboratory reports, case study analysis and presentations.

C. Graduate skills ☐ C1: Finding and using various sources of information for study and research purposes ☐ C2: Communicating with different stakeholders using verbal, written and electronic means ☐ C3: Decision-making skills ☐ C4: Teamwork skills ☐ C5: Understanding the social impact of research and practical work in the field of study ☐ C6: Presentation skills and ability to express thoughts and concepts correctly and clearly ☐ C7: Understanding fundamentals principles of research ethics	**Teaching/learning methods** Students acquire graduate skills through participation in seminars and laboratories, doing group and mini group projects, case study analysis, field trips, student presentations, completion of dissertation module, attendance on specific modules. Electronic resources will also be used to enhance student cognitive skills. **Assessment method** Students' graduation skills are assessed within the frames of evaluating their Master's thesis, laboratory reports, essays and projects

Module 1	
Title	**Monitoring and Analytical Control of Water**
Credits	7 ECTS credits, 252 academic hours
Module leader	Associate Professor, Elena Pozdina, PhD in technical sciences, Department of Water Industry and Technology Associate Professor Liudmila Ushakova, PhD in chemical sciences, Department of Water Industry and Technology
Study terms	1st year, 1-2 semesters
Aim of the module This module introduces students to analytical evaluation and environmental engineering and provides a foundation for application in the field of pollution control and water and wastewater technologies. Students will study practical aspects of environmental chemistry, quantitative measures and air, water and wastewater analysis. Special attention is paid to the principles of measurments, instrumentation and analysis using an application-oriented approach. Analytical chemistry lab works will be carried out.	
Lectures	-
Laboratory works	70 hours
Individual work	182 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth knowledge of analytical chemistry, instrumental analysis and continuous analysis
- Understand the fundamental principles of analytical evaluation

Practical skills

- Select and apply adequate methods and technologies of analysis and equipment for assessing the danger level of pollution effects
- Be able to carry out the procedures of water objects ecological monitoring

Graduate skills

- Understanding of the social impact of the activities in the field of study
- Effectively work individually and in groups

Module 2	
Title	**Basic water engineering**
Credits	5 ECTS credits, 180 academic hours
Module leader	Professor Alexander Noskov, Doctor of Technical Sciences, Head of Department of Hydraulics Associate professor Lilia Pastukhova, Department of Hydraulics Alexander An, assistant of the Department of Hydraulics, PhD student
Study terms	2nd year 1st semester

Aim of the module

In this module students will study basic principles of water engineering and basic concepts that are essetial for studying water and wastewater treatment technologies. Topics covered include the properties of fluid, manometry, hydrostatics and fundamental principles of fluid flow. Head loss in pipeline, design of pipeline, flow measurements and pipe network analysis will also be covered. Students will also learn about open channel flow and the design of surface water drainage system. Transport phenomena in fluid and in porous means; series and parallel processes; limiting step; basic of mass and energy balances; multiphase reaction engineering. Practical experiences on the fluids transportation and on the naturals to be used on fluids transportation.

Lectures	18 hours
Laboratory works	18 hours
Individual work	144 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth knowledge in the fields of hydraulics and water engineering
- Gain knowledge in the fields of equipment, procedures and methods of hydraulics and water engineering

Skills and competences

- Carry out hydraulic calculations for specific processes
- Calculate mass and heat balance
- Select standard equipment and methods for measurement and control of process parameters

Graduate skills

- Work effectively individually
- Review professional activity in reports, conference papers, etc.;
- Work effectively in groups.

Module 3	
Title	**Water ecology and human impact**
Credits	3 ECTS credits, 108 academic hours
Module leader	Prof. Alexander Nikiforov, Doctor of technical science, Department of Water Industry and Technology
Study terms	2nd year, 1st semester

Aim of the module

This module focuses on the significance and function of natural ecosystems, and how humans have affected these systems over time. It concentrates on the interaction between human activities, resources, and the environment. As the human population grows and technology advances, pressures on earth's natural systems are becoming increasingly intense and complex. This module aims to promote greater environmental awareness and nurture social responsibility towards the environment.

Lectures	18 hours
Laboratory works	18 hours
Individual work	72 hours

Learning outcomes

Knowledge and understanding:

- Acquire knowledge and understanding of the basic laws of ecology and their role in nature and society as well as regularities and mechanisms of biosphere functioning
- Gain in-depth knowledge of the models of integrated processes applied for industrial problems solving as well as management and supply of water for industrial and domestic use
- Understand interrelations between the components of the animate and inanimate nature and impact of anthropogenic factor on them
- Gain in-depth knowledge of principal peculiarities and mechanisms of functioning of organisms in the water natural environment

Skills and competences

- Evaluate the impacts of natural and anthropogenic factors on the state of water objects
- Apply physical and chemical principles to the interactions within aquatic systems
- Obtain and analyze data on rational and sustainable use of water resources

Graduate skills

- Understand the social importance of activities in the field of environmental protection
- Work effectively individually and in groups

Module 4	
Title	**Water and wastewater treatment**
Credits	8 ECTS credits, 288 academic hours
Module leader	Assistant professor Nina Petrova, PhD in Technical Sciences, Department of Water Industry and Technology, Prof. Alexander Nikiforov, Department of Water Industry and Technology
Study terms	1st year, 1st semester

Aim of the module

This module introduces the processes for treating raw water from various surface water sources to produce potable water .Students will be taught raw water quality parameters, treatment techniques, and the monitoring and operation of water treatment systems. The focus is on conventional water treatment technologies emphasizing on chemical coagulation and flocculation processes for removal of suspended and colloidal solids in raw water. Topics covered include pre-treatment of raw water, sedimentation, coagulation, flocculation, filtration and disinfection techniques. Water and wastewater treatment lab. Practical experiments are carried out in the lab, aimed at the definition of the required processes and parameters for the plants establishment.

Lectures	18 hours
Laboratory works and practical works	54 hours
Individual work	216 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth knowledge of the principal methods and technologies of water and wastewater treatment (chemical coagulation, flocculation, mechanical and biological methods)
- Understand the fundamentals principles of developing and carrying out experiments

Skills and competences

- increase the level of efficiency of water treatment due to improvement of the operation of equipment;
- design and execute laboratory experiments;
- analyze and interpret the results of experiments;
- define necessary parameters and performance characteristics of new water treatment processes using appropriate methods and techniques;

Graduate skills

- understand the social impact of the subject;
- possess the skills of teamwork;
- understand and practice research ethics

Module 5	
Title	**Membranes and membrane processes**
Credits	6 ECTS credits, 216 academic hours
Module leader	Prof. Evgeny Migalatiy, Doctor of Technical Sciences. Head of Department of Water Industry and Technology, associate professor Olga Naschetnikova, PhD in chemical sciences, Department of Water Industry and Technology, Georgy Brayalovsky, assistant of the Department of Water Industry and Technology
Study terms	1st year, 2nd semester

Aim of the module

This module aims to equip students with fundamental knowledge of membrane science and membrane applications in environmental engineering. Topics covered in this module include the types of membranes and membrane modules, the basic principles of membrane fabrication, general theory of membrane transport, membrane separation process, membrane fouling, liquid membranes, and facilitated transport. Membrane applications in water reclamation recycling and reuse will also be covered.

Lectures	18 hours
Laboratory works and practical works	54 hours
Individual work	144 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth knowledge in the sphere of membrane technologies
- Understand the principal membrane processes
- Obtain in-depth knowledge of the methods of membrane processes modeling
- Acquire knowledge of different types of membranes and membrane devices

Skills and competences

- Be able to calculate membrane processes and devices;
- Apply methods of physical and mathematical of processes going in equipment
- Develop methods and technologies of water and wastewater treatment based on membrane processes
- Carry out experiments aimed at solving industrial and domestic water problems

Graduate skills

- make decisions on membrane equipment application;
- understand the social impact of the subject;
- possess the skills of teamwork;
- understand and practice research ethics and practical exploitation of scientific results.

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Module 6	
Title	**Industrial application case study**
Credits	**6 ECTS** credits, 216 academic hours
Module leader	Professor Valentin Aksenov, PhD in chemical sciences, Department of Water Industry and Technology, Associate Professor Yury Galkin, PhD in technical sciences, Department of Water Industry and Technology Nikolay Tsarev, Assistant of the Department of Water Industry and Technology
Study terms	2nd year, 1st semester

Aim of the module

Different industrial processes result in unique type and characteristics of industrial wastewater. Considering specific pollutants and toxic substances, treatment methodology applicable for conventional domestic wastewater is not all together applicable for industrial wastewater. This module introduces students to specific industrial wastewater problems and addresses possible unit processes applicable to industrial wastewater treatment. These unit processes, along with conventional water pollution treatment techniques; can then be applied as a complete treatment flow for different industrial wastewater types. The module will cover basic physical, chemical and biological treatment technologies and also highlight specific industrial wastewater treatment methods and anaerobic treatment applications.

Lectures	18 hours
Laboratory works + practical works	54 hours
Individual work	144 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth knowledge in the sphere of methods of wastewater treatment and industrial water systems
- Gain in-depth knowledge in the sphere of physical, chemical and biological methods of industrial wastewaters treatment
- Acquire in-depth knowledge of water treatment equipment.
- Analyze and evaluate different water treatment technologies

Skills and competences

- Determine and solve problems related to wastewater treatment
- Make calculations of constructions for water and wastewater treatment
- Make balances of water management systems of industrial enterprises

Graduate skills

- make decisions on industrial equipment application;
- understand the social impact of the subject;
- possess the skills of teamwork;

Module 7	
Title	**Computer Technologies in Research and Education**
Credits	**2 ECTS** credits, 72 academic hours
Module leader	Associate professor Alexander Nekrasov, PhD in technical sceiences, Department of Water Engineering Associate Professor Yury Anikin, PhD in technical sciences, Department of Water Industry and Technology
Study terms	1st year, 1st semester
Aim of the module The discipline is devoted to studying basic principles of application of modern information technologies in design and mathematic modeling of water supply and discharge networks and appropriate software support	
Lectures	-
Practical works	36 hours
Individual work	36 hours

Learning outcomes

Knowledge and understanding:

- Acquire in-depth knowledge in the sphere of computer methods of models realization
- Acquire in-depth knowledge of IT in the field of study

Skills and competences

- Simulate processes in constructions and systems
- Apply calculation methods and apply automated design means
- Develop and apply databases for solving professional tasks

Graduate skills:

- Be able to use effectively modern IT technologies

Module 8	
Title	**Research History and Methodology in Environment Protection**
Credits	**2 ECTS** credits, 72 academic hours
Module leader	Prof. Alexander Nikiforov, Doctor of Technical Sciences, Department of Water Industry and Technology
Study terms	1st year, 2 semester
Aim of the module The module is aimed at focusing the students' attention on modern and perspective problems of research development, acquaint them with new directions of research development, especially in the field of environmental protection, in Russia and abroad. Students will study methodology of scientific inquiry, analysis and explanation of problematic facts	
Lectures	17 hours
Practical works	17 hours
Individual work	38 hours

Learning outcomes

Knowledge and understanding:

- Know history of science development and of environmental science in particular;
- Acquire knowledge of the principal research methods
- Acquire knowledge of different forms of research information
- Gain knowledge of the methods of hypotheses testing

Skills and competences

- Discover relevant problems in the interested area and to have the ability to analyse
- Acquire skills of hypotheses search having variants of problematic facts explanations
- Experimentally test accepted hypotheses

Graduate skills

- possess skills to use the algorithm of engineering problem solution for research activity;
- understand and practice research ethics and practical exploitation of scientific results.

Module 9	
Title	**Contemporary Research and Technological Problems in the field of Construction Engineering (with a focus on environmental protection)**
Credits	**2 ECTS** credits, 72 academic hours
Module leader	Associate professor Alexander Nekrasov, Department of Hydraulics
Study terms	1 year, 2 semester

Aim of the module

This practically oriented module is aimed at acquainting the students with different technological processes in the field of construction, mechanisms of project implementation, methods of defining and solving research and technological problems

Lectures	-
Practical works	34 hours
Individual work	38 hours

Learning outcomes

Knowledge and understanding

- Gain in-depth knowledge of technological processes related to design and building of water treatment constructions
- Gain knowledge of equipment used in technological processes

Skills and competences:

- Carry out technical and economical analysis of projects
- Make research and technological decisions at the stages of design and implementation

Graduate skills

- Be able to apply practically theoretical knowledge
- Make professional decisions

Module 10	
Title	**English Language**
Credits	6 ECTS credits, 216 academic hours
Module leader	Assistant professor Tamara Pyrkova, Department of Foreign Languages
Study terms	1st year, 1-2 semesters
Aim of the module The module is aimed at teaching students to apply foreign languages for professional purposes: translation and writing of technical texts, work win documentation in a foreign language, effective communications with different stakeholders. The teaching process comprises communicative activities, practical exercises, group work, presentations and assignments.	
Lectures	-
Seminars	106 hours
Individual work	110 hours

Learning outcomes

Knowledge and understanding:

- Demonstrate the confidence in English at the level necessary for carrying out effective communications in business and research spheres

Skills and competences

- Translate subject-specific texts
- Create research and technical texts in English
- Be able to participate in oral and written communications in English

Graduate skills

- Communicate effectively with different stakeholders
- Use language for educational, research and business purposes

Module 11	
Title	**Approved practical research experience**
Credits	**57 ECTS** credits, 2052 academic hours
Module leader	All the teachers of the course supervise students' research
Study terms	All 4 semesters of the programme

Aim of the module

In this module students will be attached to a scientific supervisor in industrial organizations / research centres /university laboratories during all the study period. This is to include them to research and practical activity and to prepare them for future employment. During these research activities, they will undertake projects and tasks assigned by the organizations. This allows them the opportunity to take initiatives as well as to develop their self-confidence, interpersonal and adaptation skills.

Learning outcomes

Knowledge and understanding:

- Acquire in-depth knowledge in the field of preparing research

Skills and competences:

- Be able to implement projects and tasks
- Carry out necessary experimental work
- Formalize research results

Graduate skills:

- Have presentation skills
- Be able to communicate with different stakeholders
- Know the fundamentals principles of research ethics

Module 12	
Title	**Master Thesis**
Credits	**3 ECTS** credits, 108 academic hours
Module leader	Each teacher supervises some of the students
Study terms	2nd year, 2 nd semester -

Aim of the module

The module is aimed at carrying out independent supervised research work. It allows the students to demonstrate the level of their research qualification, ability to carry out scientific inquiries and solve research tasks. The content of the Master's thesis should be characterized by relevance and uniqueness. The Master's thesis addresses the most relevant problems of industrial and domestic water and wastewater treatment, advanced technologies and methods.

Learning outcomes

Knowledge and understanding:

- Acquire in-depth subject-specific knowledge in accordance with the research theme

Skills and competences:

- Formulate research problems and find algorithms of solution
- Critically analyze information
- Make analysis-based conclusions
- Systematize information
- Apply practical results obtained experimentally

Graduate skills

- Express ideas and concepts clearly
- Have presentation skills

Elective modules

Module 1	
Title	**Processes and apparatus of wastewater and sludges treatment / Basics of industrial design for water treatment constructions**
Credits	3 ECTS credits, 108 academic hours
Module leader	Associate professor Yury Galkin, PhD, Department of Water Industry and Technology Nikolay Tsarev, Assistant of Department of Water Industry and Technology
Study terms	2nd year, 1 semester
Aim of the module The course is aimed at acquainting students with the main processes and apparatus of wastewater and sludges treatment, using automatic means of industrial design, methods of calculation of constructions and systems, regulations for preparing technical documentation.	
Lectures	-
Practical works	36 hours
Individual work	72 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth understanding of the principles of industrial design
- Acquire knowledge of the main processes of wastewater treatment and equipment used

Skills and competences

- Be able to make project decisions
- Calculate constructions and systems for wastewater treatment
- Prepare technical documentation in the field of wastewater treatment in accordance with regulations

Graduate skills

- To be able to make problem-related practical decisions

Module 2	
Title	**Ecological expertise and control**
Credits	3 ECTS credits, 108 academic hours
Module leader	Associate Professor Yury Grigoriev, PhD in technical sciences, department of Water Industry and Technology
Study terms	2 year, 1 semester

Aim of the module

The course acquaints students with the main regulatory acts in the sphere of state control and state ecological expertise. Main principles of calculation of maximum permissible discharge for enterprises are studied. Students learn to use software means for calculation of normative and maximum permissible discharge

Lectures	18 hours
Laboratory works + practical works	18 hours
Individual work	72 hours

Learning outcomes

Knowledge and understanding:

- Acquire knowledge of the principal regulatory acts and fundamentals of the state policy in the sphere of environmental protection

Skills and competences

- Be able to use software for calculating normative permissible discharge
- Be able to make project decisions on the basis of legal regulations

Graduate skills

- Analyze and employ different sources of information for professional purposes
- Apply information technologies

Module 3	
Title	**Experimental studies of wastewater treatment**
Credits	7 credits, 252 academic hours
Module leader	Associate professor Olga Naschetnikova, Department of Water Industry and Technology
Study terms	1 year, 1-2 semester
Aim of the module The module is highly practice-oriented; it is aimed at studying advanced technologies and materials, principles of experimental work, regulations for reporting the results obtained experimentally.	
Lectures	-
Laboratory works	70 hours
Individual work	182 hours

Learning outcomes

Knowledge and understanding

- Gain in-depth knowledge of the principles of experimental work
- Understand the regulations for reporting research results
- Gain in-depth knowledge of physical chemical and biological processes in water discharge and water treatment systems
- Acquire knowledge of new reagents and materials for wastewater treatment systems

Skills and competences

- Carry out research and technological surveying
- Develop innovative processes, technologies and materials
- Carry out experiments
- Report correctly the results of experiments
- Select the most effective technologies of water treatment

Graduate skills

- Know the fundamental principles of research ethics
- Express thoughts and concepts correctly and clearly

Assessment strategy and methods

- Internal current control of student progress according at the end of semester
- Oral presentations
- Field practice reports
- Written reports, essays (including references, etc)
- Tests after each topic, course exams, master thesis assessment.
- Peer review and evaluation by the group
- Self-evaluation

Quality assurance

Internal

- General expert evaluation by the project Evaluation board
- Students feedback

External

- Evaluation by European academics from partner universities,
- Accreditation of the programme by AKKORK (The Agency for Higher Education Quality Assurance and Carrier Development),
- Ministry of Education and Science of RF official recognition (licensing)
- Evaluation by employers

Employment opportunities

Fields:

- ☐ Research and technological development of innovative processes, wastewater equipment
- ☐ Design, construction, reconstruction and operation of networks and equipment of industrial and domestic systems of water discharge
- ☐ Pedagogical activities
- ☐ Control and supervisory activities
- ☐ Managerial activities

Organizations:

- ☐ Research institutions, production, planning and surveying organizations in the spheres of construction engineering, water supply and discharge of industrial objects and communities, operational services of water discharge engineering systems
- ☐ State and municipal organizations working in the spheres of housing and utilities sector, environmental protection sector
- ☐ Organizations inspecting construction objects
- ☐ Higher and intermediate educational institutions

List of study and methodological guides of the Department of Water Industry and Technology used in the study process

1) Application of flocculants in water carriage systems; editor: Aksenov V.I.

2) Application of flocculants in water and wastewater treatment; editors: Aksenov V.I., Anikin Y.V.

3) Physical and chemical foundations of natural and wastewater treatment; editors: Nikiforov A.F., Migalatiy E.V.

4) Mass exchange processes and apparatus; editor: A.F. Nikiforov

5) Guidelines for laboratory works "Production of drinking water on local installations"; editors: Migalatiy E.V., Nikiforov A.F., Brayalovsky B.S.

6) Water discharge networks; editor: Petrova N.A.

7) Organization, planning and carrying out research work; editors: Grigoriev Y.O., Nikiforv A.D., Petrova N.A., Migalatiy E.V.

8) Basics of hydrogeology; editors: Shishmakov S.Y., Nikiforov A.F., Anikin Y.V.

9) Guidelines for preparing research papers for the academic major "Water discharge and wastewater treatment"; editors: Petrova N.A., Grigoriev Y.O.

10) Guidelines for preparing a project "Station of biochemical wastewater treatment"

Recommended literature

1) Veitzer Y.I. High-molecular flocculants in natural and wastewater treatment processes/ M. Stroyizdat, 1984. 201 p.

2) Nebera V.P. Flocculation of mineral suspensions/ M. Nedra. 1983. 288 p.

3) Zapolsky A.K. Coagulants and flocculants in water treatment processes: Properties. Production. Use./ L. Chemistry. 1987. 213 p.

4) Topchiev D.A. Cationic polyelectrolytes: production, properties and use/ M. Akademkniga. 2004. 232 p.

5) Adler Y.P., Markova E.V., Granovsky Y.V. Planning of experiments and searching optimum conditions./ M. Nauka, 1976. 272 p.

6) Abramzon A.A. Surface-active substances./ L. Chemistry. 1981. 304 p.

7) Rules of surface waters protection./ M. 1991

8) Water discharge and wastewater treatment./ S.V. Yakovlev, Y.A. Karelin, Y.M. Laskov, V.I. Kalitsun. Stroyizdat. 1996

9) Kalitsun V.I. Water discharge systems and constructions./ M. Stroyizdat. 1987

10) Baranova D.A. Processes and apparatus/ M. Academia. 2004

11) Gelperin N.I. Processes and apparatus of chemical technology./ L. Chemistry. 1981

12) Gindin L.M. Extraction processes and their application. / M. Nauka. 1984.

13) Dubinin M.M. Adsorption. / M. Nauka. 1987

14) Dytnersky Y.I. Membrane separation methods. / M. Chemistry. 1975

15) Kasatkin A.G. Main processes and apparatus of chemical technology. / M. Chemistry. 2002

16) Yakovlev S.V., Skirdov N.V., Shvetsov V.N., Bondarev A.A., Andrianov Y.N. Biological Purification of Industrial Wastewater. Processes, Devices and Structures. / M. Stroyizdat, 1985.-208 p.

17) Naydenko V.V., Kulakova A.P., Sherenkov I.A. Optimization of Natural and Waste Water Purification. / M. Stroyizdat, 1984.-151 p.

18) Chemistry of Industrial Wastewater./ M. Chemistry, 1983.-360 p.

19) Nikoladze G.I.., Somov M.A. Water supply. M.: Stroyizdat, 1995.

20) Manual in natural and wastewater treatment. L.Paal and authors. M. Vishaya shkola. 1994.

Curriculum map

Module	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5		C1	C2	C3	C4	C5	C6	C7	
Monitoring and Analytical Control of Water	**X**	**X**	X		X	X	X	X			X	X	X		**X**		X	X	**X**	X	**X**	
Basic water engineering	**X**		**X**		X	**X**	**X**	X	X	X	**X**	X			**X**		**X**	**X**	**X**		**X**	
Water ecology and human impact	X		X		**X**		**X**	**X**			**X**	**X**			**X**		X	**X**	**X**		**X**	
Water and Wastewater Treatment	**X**	**X**	**X**		**X**	X	**X**	**X**	**X**	**X**	**X**	**X**			**X**		X	**X**	**X**		**X**	
Membranes and membrane processes	X	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**			**X**		**X**	**X**	**X**		**X**	
Industrial Application Case Study	X	**X**	X		**X**	X	**X**	**X**	**X**	**X**	**X**	**X**	X		**X**	**X**		**X**	**X**		**X**	
Computer Technologies in Research and Education			**X**										X		**X**							
Research History and Methodology in Environment Protection					X		**X**				**X**	X			**X**		X				**X**	
Contemporary Research and Technological Problems in the field of Construction Engineering (with a focus on environmental protection)	**X**	**X**	**X**		X			X	**X**	**X**	**X**	X			**X**		X	**X**	X		**X**	
English Language															**X**	**X**				X		
Processes and apparatus of wastewater and sludges treatment / Basics of industrial design for water treatment constructions	**X**	**X**	**X**		X	X	**X**		**X**	**X**	**X**	X	**X**		**X**		X	**X**	X	X	**X**	
Ecological expertise and control	**X**				X	X	**X**				**X**	X	**X**		**X**		X		X	X		
Experimental studies of wastewater treatment	**X**	**X**	**X**		X		**X**		**X**	**X**	**X**	X			**X**		X	**X**		X	**X**	
Approved Practical Experience	X	X	X					X	**X**	**X**	**X**	**X**			**X**	**X**	**X**		**X**	**X**	**X**	
Master Thesis	X	X	X		X	X	X	X	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	

	Knowledge and understanding			
A1	In-depth knowledge of theoretical foundations of different water processes		**B4**	Conduct laboratory and field experiments, collect, analyse and interpret data
A2	Understanding of criteria for selecting technological water and wastewater treatment processes		**B5**	Use appropriate information technologies for professional and management purposes
A3	Understanding of the principles of managing and improving technological processes			
A4	In-depth knowledge of membrane technologies			**Graduate skills**
A5	In-depth knowledge of experimental methods of data obtaining		**C1**	Finding and using various sources of information for study and research purposes
A6	Understanding of statistical methods of data analysis		**C2**	Communicating with different stakeholders using verbal, written and electronic means
A7	Evaluation and critical analysis		**C3**	Decision-making skills
A8	Understanding the socio-economic factors impacting effective water solutions		**C4**	Teamwork skills
	Practical skills		**C5**	Understanding the social impact of research and practical work in the field of study
B1	Practical skills in domestic water supply and wastewater treatment		**C6**	Presentation skills and ability to express thoughts and concepts correctly and clearly
B2	Practical skills in industrial water supply and wastewater treatment		**C7**	Understanding fundamentals principles of research ethics
B3	Skills of selecting and using and use appropriate methods and technologies for water use, reuse, recycling and purification			