MASTER PROGRAMME
“COMPLEX USAGE OF WATER RESOURCES”

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
Vladimir State University, Russia
Bauman Moscow State Technical University, Russia
Ural Federal University, Russia

European Commission
TEMPUS

TAMBOV STATE TECHNICAL UNIVERSITY
2011

University	**Tambov State Technical University, TSTU, Russia**
Programme level	**Master level**
Status	**Joint International Programme**
Name of the course	**Complex Usage of Water Resources** **280200.04**
Field and classification code	**Protection of Environment** **280200 (Russian education classification code)**
Qualification	**Master of Engineering and Technology**
Web-site	**Website http://www.tstu.ru/r.php?r=structure.kafedra&id=5**
Faculty	**Noospheric safety and law**
Address	**TSTU, Chair of Nature Management and Environment Protection, 112a Michurinskaya Street, 392032 Tambov**
Course length	**2 years**
Workload	**According to ECTs - 120 credits (Russian education standard – 4068 academic hours)**
Start date	**October 2010**
Professional recognition	**The following stakeholders have been consulted for the designing of the Course programme:** **Tambov Regional Administration, Department for Environmental Protection and Natural Resources, 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
Final qualification work (project) (1 week = 1,5 RCU)

Aims of the programme:
To provide scientific technological knowledge on purification, technical management and using of water. The Master programme trains experts with in depth skill in the field of water treatment by traditional processes as well as innovative membrane technologies, which can be used to improve water resource quality. Expertise on sustainable development of water resources, with specific reference to the making usable, reclaimable and recyclable for domestic, industrial and agricultural using of water, independently from the original sources features. The Master is thoroughly labour market-oriented thanks to the focusing on the management of purification

treatments, water reclamation and potabilization. The study programme is designed on the basis of link between consolidated technical-scientific knowledge and applied aspects of innovative research, so that the Master aims at reinforcing connections between such training and professional skill demanded by the labour market. The credit system adopted for the certification of the achieved competences will be based upon academic courses, internships, laboratory activities.

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.
- **English language is assessed at an interview**
- Overseas candidates are required to have the certificate of Russian language course attendance.

Teaching methods

Seminars, research supervision, practices, creative workshops, problem solution classes, laboratory classes, internships, mobilities, field practice, e-learning

The peculiar feature of the programme is introducing the **latest international education achievements** into it. They are:

1. Tuning methodology
2. Dublin descriptors
3. ECTs

According to "Dublin Descriptors" Qualifications that signify completion of the second cycle are awarded to students who have completed a programme of study that enables them to show:

• knowledge and comprehension that is founded upon, extends and enhances that associated with the Bachelor's level and is at the forefront of a field of learning
• a critical awareness of current problems and new insights, new tools and new processes within their field of learning, or the development of professional skills
• that they can apply their knowledge and comprehension, their critical awareness and problem solving abilities, within the context of research, or in the development of professional skills, in broader or multidisciplinary areas related to their fields of study
• that they have the ability to integrate knowledge and handle complexity, to formulate judgements with incomplete or limited information, either individually or in groups, which includes (where relevant) reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements
• that they can lead or initiate activity, and take responsibility for the intellectual activities of individuals or groups
• that they can communicate their conclusions, and knowledge, rationale and processes underpinning these, to specialist and non-specialist audiences clearly and unambiguously
• that they possess the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

Considering the above the programme will develop the following competences (or generic skills):

Students will develop the strategic, managerial and technical skills they need to advance in the water sector. They will become familiar with all aspects of integrated water resource management; be capable of providing water management expertise to help reduce poverty through equitable and sustainable use of water; be skilled to provide technical and managerial input into planning, design and operation of water projects and facilities; understand the principles of managing water supply, wastewater treatment and urban infrastructure projects; recognise the socio-economic factors impacting on effective water solutions; and understand the governance and institutional frameworks underpinning water resource management. The program focuses on building the skills base of students in such areas as critical thinking, engineering problem solving, statistics, data and project management, knowledge transfer and effective leadership, IT technologies application, communication and negotiation, teamwork and people management.

Programme structure

Compulsory subjects

- Membranes and Membrane processes
- Water engineering
- Water ecology and human impact
- Monitoring and analytical control of water
- Industrial application case study
- Water and wastewater treatment
- English language

Desirable subjects

- Contemporary Issues of Environment Protection Research
- Research History and Methodology in Environment Protection
- Computer Technologies in Research and Education

Programme Outcomes

A. Knowledge and understanding 1. Gain in-depth knowledge and understanding of all aspects of integrated water resource management 2. Understand the principles of managing water supply, wastewater treatment and urban infrastructure projects; 3. Consider the socio-economic factors impacting on effective water solutions; 4. Understand the governance and institutional frameworks underpinning water resource management 5. Acquire in-depth knowledge of water treatment technologies 6. In-depth knowledge of innovative membrane technologies 7. Gain knowledge of the necessary theories, mathematical, analytical concepts and models to solve water problems 8. Critically evaluate current methods of water (domestic and industrial) treatment	**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 1. Be able to provide technical and managerial input into planning of water projects and facilities (in native language and in English); 2. Solve engineering problems through the application of theoretical concepts and practical knowledge in industrial setting 3. Conduct laboratory and field experiments, collect, analyse and interpret data 4. Select and use appropriate methods and technologies for water use, reuse, recycling and purification 5. Use appropriate information technology for professional and management purposes (e.g. risk analysis) 6. Modeling a variety of natural and industrial water systems	**Teaching/learning methods** Students learn cognitive skills through attendance in seminars and laboratories, 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. A specific accent in the assessment is made on the ability of a student to critically classify, asses, debate, interpret and operate.

C. Graduate skills	Teaching/learning methods
1 Develop critical thinking and carry out research (e.g. Present critically and compare their own views and those that differ from their own in native language and in English). 2 Identify and use various learning sources in students' scientific occupations. 3 Communicate and negotiate effectively with different stakeholders individually and in-group using verbal, written and electronic modes of communication (in native language and in English). 4 Make informed professional decisions based on scientific knowledge and appropriate criteria. 5 Work effectively individually or in groups to accomplish assigned tasks. 6 Develop efficient time management skills. 7 Appreciate the social impact of research and practical work in the field of study 8 Reflect and evaluate on own learning and evaluate peers in a professional manner.	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 by dissertation module, laboratory reports, essays, group project and data analysis assessment.

Module 1	
Title	**Monitoring and Analytical Control of Water**
Credits	8 ECTS credits, 250 academic hours
Module leader	Assistant Professor, Irina Yakunina, PhD , Chair "Nature Management and Environment Protection", Ph.D, assistant Natalia Belyaeva, Head of Laboratory, Chair "Nature Management and Environment Protection", Post-graduate student
Study terms	1st year, 2nd semester, 2nd year, 1st semester

Aim of the module

This module introduces students to the field of the analytical evaluation and environmental engineering and provides a foundation for applications in pollution control and water and wastewater technology. Students will study the practical aspects of environmental chemistry, quantitative measurements and analysis of air, water and wastewater. Principles of measurement, instrumentation and analysis are emphasized using an application-oriented approach. Analytical chemistry lab exercises will be carried out

Lectures	51 hours
Laboratory works	34 hours
Individual work	165 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth knowledge of environmental chemistry, quantitative measurements and analysis of air, water and wastewater
- Engage in analytical evaluation of water quality characteristics and standards
- Study the principles, approach, methods and equipment for quality control of water
- Compare and evaluate different structures of monitoring systems

Practical skills

- Apply appropriate methods of analysis
- Monitor aquatic systems against industrial enterprise dangerous influence
- Manage the monitoring procedures of water objects
- Measure properties and use instrumentation for analysis of water samples
- Conduct tests and carry out laboratory experiments
- Design forecasting models

Graduate (or Transferable) skills

- Decision making
- Group work
- Manage Time
- Carry out research and develop critical thinking

Module 2	
Title	**Basic water engineering**
Credits	8 ECTS credits, 250 academic hours
Module leader	Prof. Nikolay Zhukov, Head of the Chair "Hydraulics and Heat Engineering", Doctor of Technical Sciences, Senior Lecturer Alexey Chekh, Chair "Hydraulics and Heat Engineering", PhD
Study terms	1st year, 1st semester, 2nd year, 1st semester

Aim of the module

In this module, students will examine the basic hydraulic principles and fundamental concepts that are essential for the study of water and wastewater 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	51 hours
Laboratory works	34 hours
Individual work	165 hours

Learning outcomes

Knowledge and understanding:

- advanced understanding of engineering processes relevant to the water industry such as hydraulic calculations; heat calculations;
- gain deep knowledge of main notions and theories of hydraulic engineering;
- obtain in-depth knowledge of hydraulic equipment of different types used in water systems;
- advance understanding of main directions and perspectives of water system development.

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Skills and competences

- apply engineering processes relevant to the water industry such as : hydraulic calculations; heat calculations;
- collect, process, analyse data and research in hydraulic engineering;
- apply received information, equations and formulas to hydraulic engineering.

Graduate skills

- make informed decision about the selection of standard equipment and methods of measurement and control of main process parameters;
- work effectively individually;
- present received results to the public;
- review professional activity in reports, conference papers, etc.;
- work effectively in groups.

Module 3	
Title	**Water ecology and human impact**
Credits	4 ECTS credits, 104 academic hours
Module leader	Assistant Professor Galina Volodina, Chair "Nature Management and Environment Protection"
Study terms	1st year, 1st semester'"

Aim of the module

Ecology is the study of living things in their natural environment. 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	34 hours
Laboratory works	17 hours
Individual work	53 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 general notion of water sector governance and legal acts;
- advanced understanding of biogeochemical processes and links between physical and chemical processes and water ecosystem functioning;
- obtain in-depth knowledge of principal peculiarities and mechanisms of functioning of organisms in the water natural environment;
- understand interrelations between the components of the animate and inanimate; nature and impact of anthropogenic factor on them.

Skills and competences

- apply physical and chemical principles to the interactions within aquatic systems and partitioning of pollutants within biotic and abiotic environmental compartments;
- evaluate water quality through interpretation of physical and chemical data;
- evaluate the impacts of natural and anthropogenic factors on the state of water objects;
- analyse and receive data on rational and sustainable use of water resources.

Graduate skills

- review practical research results and make new decisions;
- represent professional activities in reports, conference papers;
- communicate professional activity in discussions, conferences, etc;
- individual research conducting.

Module 4	
Title	**Water and wastewater treatment**
Credits	9 ECTS credits, 300 academic hours
Module leader	Senior Lecturer Alexey Chekh, Chair "Hydraulics and Heat Engineering", PhD, Natalia Belayeva, Head of Laboratory, Chair "Nature Management and Environment Protection"
Study terms	1st year, 2nd semester, 2nd 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	51 hours
Laboratory works	68 hours
Individual work	181 hours

Learning outcomes

Knowledge and understanding:

- understand modern technology and practices for wastewater collection, treatment and disposal and water treatment;
- demonstrate how theoretical concepts may be used to obtain design criteria that can serve as management tools to develop cost-effective operational systems;
- gain deep knowledge of core and advanced unit processes and design technology for the operation of drainage and wastewater treatment systems, as well as water treatment systems;
- understand design and analysis techniques for water and wastewater systems.

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;
- analyze and select the newest methods of water treatment equipment design and aspects of water treatment plants.

Graduate skills

- understand the social impact of the subject;
- possess the skills of teamwork;
- understand and practice research ethics and practical exploitation of scientific results;
- manage time efficiently.

Module 5	
Title	**Membranes and membrane processes**
Credits	8 ECTS credits, 250 academic hours
Module leader	Mikhail Ryabinsky, PhD, Assistant at the Chair "Nature Management and Environment Protection", Alexey Perepelkin, Head of Department "Industrial Ecology" of JSC "Elektropribor", Assistant Irina Shchukina, Engineer of Chair: "Processes and Devices of Chemical Engineering
Study terms	1st year, 2nd semester, 2nd year, 1st 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. Membrane processes.	
Lectures	51 hours
Laboratory works	51 hours
Individual work	148 hours

Learning outcomes

Knowledge and understanding:

- acquire knowledge and understanding of basic methods of wastewater treatment, physical, chemical and physical-chemical content of environment protection processes;
- understand and be able to apply membrane processes and to use appropriate equipment;
- gain in-depth knowledge of different types of membranes and membrane devices;
- obtain in-depth knowledge of mathematical modelling for membrane processes.

Skills and competences

- apply methods of mathematical and physical modelling of processes going in equipment;
- apply and manage membrane processes;
- use and manage membrane technologies;
- carry out experimental tests aimed at solving industrial and civil problems;
- use appropriate equipment for water reclamation, recycling, reuse;
- participate in laboratory-based application of membrane theories to develop new membranes.

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	**3 ECTs** credits, 100 academic hours
Module leader	Dr. Alexey Perepelkin, Head of Department "Industrial Ecology" of JSC "Elektropribor", Prof. Nikolay Popov, Head of the Chair "Nature Management and Environment Protection", Doctor of Technical Sciences Mikhail Ryabinsky, PhD, Assistant at the Chair "Nature Management and Environment Protection",
Study terms	1st year, 2nd semester', 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. This 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	34 hours
Laboratory works	34 hours
Individual work	32 hours

Learning outcomes

Knowledge and understanding:

- obtain advanced knowledge and understanding of the specific sanitary and water supply requirements suitable for developing countries;
- acquire in-depth knowledge of methods of water system treatment used in industry;
- develop an advanced understanding of the basis of physical, chemical or biological processes and technologies of industrial water treatment and aerobic and anaerobic treatment;
- compare and evaluate water treatment methods;
- gain deep knowledge of water treatment equipment.

Skills and competences

- apply and design appropriate sanitation facilities;
- determine and eliminate wastewater problems;
- use properly the equipment for water purification (portable water, industrial water and for domesticities).

Graduate skills

- make decisions on industrial 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.

Module 7	
Title	**Approved practical research experience**
Credits	27 **ECTS** credits, 954 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 Execute projects and tasks given by a lead organization during the master's internship. Conduct research based experimental work, results receiving, accuracy and authenticity proving, review of data, discovering cause-effect relations, determination of research innovative and relevant features.	

Module 8	
Title	**Master Thesis**
Credits	**30 ECTs** credits, 1080 academic hours
Module leader	Each teacher supervises some of the students
Study terms	2nd year, 2 nd 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. This 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.	
Learning outcomes Preparation of the Master's Thesis and Final State Examination Valuable practical results of master thesis. Their application for the regional economy.	

Module 9	
Title	**English Language for Environmental Studies**
Credits	3 ECTS credits, 80 academic hours
Module leader	Dr.Lilia Mozerova, Head of International Office
Study terms	1st year, 1st semester'"
Aim of the module This module of English is an intensive program for students for whom English is a second or additional language. This intensive program can help students build their English language skills for success in university, research or career and in environmental carrier in particular. The course includes important environmental vocabulary and texts on water topics. The program emphasizes highly effective academic communication skills by focusing on four skill areas – reading, writing, speaking and listening, as well as academic study skills. The teaching process comprises communicative activities, practical exercises, group work, presentations and assignments.	
Lectures	34 hours
Laboratory works	-
Individual work	46 hours

Learning outcomes

Knowledge and understanding:

Skills and competences

- demonstrate the confidence and listening/speaking skills necessary to participate successfully in spontaneous oral exchanges with native speakers of English in a variety of personal, professional, and/or academic settings;
- demonstrate reading comprehension of English texts intended for developmental (or higher level) English courses.
- respond appropriately to written or spoken English by writing paragraphs or short essays that communicate ideas clearly.

Graduate skills

- make professional presentations in English
- communicate and negotiate effectively in English with different stakeholders.
- use language to think and reason, as well as to access, process and use information for learning.

Desirable Modules

Module 1	
Title	**Contemporary research problems in environmental protection**
Credits	6 ECTS credits, 200 academic hours
Module leader	Professor Nikolay Popov, Head of the Chair "Nature Management and Environment Protection", Doctor of Technical Sciences
Study terms	1st year, 1st and 2nd semester
Aim of the module	
To attract students attention to current and future problems of contemporary society, to show them new directions in research development, especially in environmental studies, to transfer knowledge of new technologies, equipment, devices, methods and research results.	
Lectures	51 hours
Laboratory works	17 hours
Individual work	132 hours

Learning outcomes

Knowledge and understanding:

- acquire knowledge and understanding of basic methods of environmental protection, physical, chemical and physical-chemical content of environment protection processes;
- understand each new environmental problem, its peculiarities;
- understanding principal legal acts and fundamentals of policy in the sphere of environment protection.

Skills and competences

- find the possible ways of environment protection problems solution;
- choose effective equipment and materials for environment protection;
- collect appropriate information and data and make its statistical analysis;
- forecast possible problem situations in environment.

Graduate skills

- make decisions according to knowledge of technology and tendencies of production capacity development ;
- use information resources for support and decision making in ecology;
- understand the social impact of the subject;
- possess the skills of teamwork;
- understand and practice research ethics and practical exploitation of scientific results.

Module 2	
Title	**Computer technologies in research and education**
Credits	8 ECTS credits, 300 academic hours
Module leader	Assistant Professor Valery Luzgachev, Chair "Nature Management and Environment Protection"
Study terms	1 year, 2 semester, 2 year, 1 semester

Aim of the module

This module aims at teaching students analyzing ecological situations with using databases, GIS technologies, geoinformatics, cartographic methods.

Lectures	34 hours
Laboratory works	34 hours
Individual work	232 hours

Learning outcomes

Knowledge and understanding:

- gain knowledge of GIS development;
- understand GIS application;
- knowledge of main stages of project management;
- obtain knowledge of different data models.

Skills and competences

- model different environmental objects;
- present information with the help of maps;
- structure geographical data;
- develop geo databases;
- model different infrastructures, raster and vector data.

Graduate skills

- understand the social impact of the subject;
- possess the skills of teamwork;
- work effectively individually or in groups to accomplish assigned tasks.

Module 3	
Title	**Research history and methodology in environment protection**
Credits	6 credits, 200 academic hours
Module leader	Natalia Belyaeva, Head of Laboratory, Chair "Nature Management and Environment Protection"
Study terms	1 year, 1 semester

Aim of the module
This module aims at teaching students bases of research in natural, engineering and humanitarian sciences.

Lectures	34 hours
Laboratory works	
Individual work	166 hours

Learning outcomes
Knowledge and understanding:

- know history of science development and of environmental science in particular;
- obtain peculiarities of cognition and scientific criteria;
- differ main methods of scientific research;
- know main forms of research information (empiric facts, hypotheses, models, laws, theories, problems, etc);
- understand concepts and principles of the system theory, system characteristics and properties.

Skills and competences

- discover actual problems in the interested area and to have the ability to analyse;
- acquire skills of hypotheses search having variants of problematic facts explanations;
- gain knowledge of theoretical and experimental testing of adequacy;
- use the system theory.

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.

Assessment strategy and methods

- Internal current control of student progress according to IQ-net and ISO-9000 procedures (at the end of semester)
- Oral presentations
- Field practice reports
- Professional portfolio
- Written reports, essays (including references, etc)
- Tests after each topic, course exams, master thesis assessment.
- Posters
- 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

The programme graduates will be able to hold positions of responsibility in the chemical industry, chemical-pharmaceutical industry, municipal and utility enterprises, food industry, textile industry in the production, research and quality control processes. Public authorities involved in environmental issues and policies, water treatment and membrane technologies using, also linked to the industrial process of separation (food, chemistry, iron & steel ones). They can also work as industrial consultants for safety in the workplace.

Learning resources available at the chair "Nature Management and Environment Protection" (bought in the frames of the project)

1. System hydraulics
2. Zhurba, M. G Water diverting and waste disposal plants and devices
3. Molchanova Ya.P Hydro chemical indicators of environment situation
4. Xenze, M. Wastewater treatment: Biological and chemical processes.:Textbook for universities (Translation from English. Mosolova T.P.) / Publishing house "MIR", 2004.
5. ISBN 5-03-003430-7
6. Turovsky I.S. Wastewater mud. Dewatering and decontamination.
7. Colesnkov V.A. Analysis, technology and devices for wastewater treatment
8. . Ryabchikov, B.E. Modern methods of water treatment for industrial and housing: Potable water; Food industry, Power engineering, Daily Print, 2004, ISBN: 5-94343-079-2
9. Turin O.G. Control over potentially harmful technologies
10. Xenze M. Armoes Y, La Cur Yansen, Arvan E, Wastewater treatment: Biological and chemical processes.
11. Alexeev, E.V. Fundamentals of wastewater treatment by flotation
12. Boikova I.G., Volshanik V.V. Water sources operation, reconstruction and conservation in city
13. Bryanskaya Yu.V. Hydraulics of water and suspended flows in rigid and deformed limits
14. Volshanik V.V. Classification of urban water
15. Voronov 7-11 Textbook for part time students
16. Voronov III-5 Textbook for part time students
17. Voronov IV-7 Textbook for part time students
18. Voronov IV-8 Textbook for part time students
19. Voronov V-10 Textbook for part time students
20. Voronov V-9 Textbook for part time students
21. Voronov Yu. V. Water drainage and sewage treatment: Textbook for universities - M: Association of construction universities, 2006
22. Grigorieva L.S. Physical and chemical assessment of natural water quality and water treatment
23. Zhurba, M. G. Water supply. Volume 1/ - M: Association of construction universities.
24. Zhurba, M. G. Water supply. Volume 2/ - M: Association of construction universities.
25. Zhurba, M. G. Water supply. Volume 3/ - M: Association of construction universities.
26. Kichigin, V. I. Water drain systems of industrial enterprises
27. Kichigin, V. I. Modeling of water treatment processes: Textbook for universities - M: : Association of construction universities, 2003. ISBN 5-93093-218-2
28. Pervov A.G. Modern high efficiency technology of water treatment with membrane application
29. Pugachev V.A. Processes and apparatus of wastewater mud processing
30. Pugachev V.A. Technology of effective water consumption in industry
31. Syriddinov S.Sh. Hydraulics of water supply and water drainage systems
32. Serpokrylov N.S. Ecology of wastewater treatment by physical and chemical methods
33. Sokolov L.I. Resource saving technologies in water system of industrial enterprises
34. Somov M.A. Water supply Part 1

35. Somov M.A. Water supply Part 2
36. Modeling flows in environment
37. Spellmans standard handbook
38. Biological wastewater treatment
39. Water quality and treatment

Recommended literature

1. Bertoks P., Radd D. Strategy of Environment Protection from Pollution.-M.: Mir, 1989.-606 p.
2. Biswas A.K. Water Resources: Environmental Planning, Management and Development. Mc. Graw Hill, 1996.-737 p.
3. Braginskiy L.N., Evilevich M.A, Begachev V.I. Modeling of Aeration Structures for Wastewater Purification. - L.: Chemistry, 1980.-144 p.
4. Chebotarev A.I. Hydrological Dictionary. - L.: Gidrometeoizdat, 1978. -308 p.
5. Chedgaev R.R. Hydraulic Terms. - M.: Higher School, 1974.-104 p.
6. Chemistry of Industrial Wastewater. - M.: Chemistry, 1983.-360 p.
7. Ebbot M.B. Hydraulics of Open-channel Flow. – M .: Energoatomizdat, 1983.-272 p.
8. Forecasting of Hydrogeological Circumstances Changes under the Influence of Water-related Activities. – M.: Nedra, 1987.-205 p.
9. Frid J. Pollution of Ground Waters. Theory, Procedure, Modeling and Practical Methods. - M.: Nedra, 1981.-304 p.
10. Golubovskaya E.K. Biological Foundations for Water Purification. - M.: Higher School, 1987.-268 p.
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Curriculum map for MSc Complex Usage of Water Resources

Module	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	C7	C8
Water Ecology and Human Impact	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	X
Membranes and Membranes Technologies					X	X	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		X	
Monitoring and Analytical Control of Water		X	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
Computer Technologies in Research and Education			X	X			X		X				X	X	X	X	X			X	X	
English Language									X				X			X	X					
Contemporary Issues of Environment Protection Research	X	X	X	X			X		X	X	X		X	X	X	X		X			X	X
Research History and Methodology in Environment Protection	X	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

Programme outcomes:

	Knowledge and understanding			
A1	Gain in-depth knowledge and understanding of all aspects of integrated water resource management		**B4**	Select and use appropriate methods and technologies for water use, reuse, recycling and purification
A2	Understand the principles of managing water supply, wastewater treatment and urban infrastructure projects		**B5**	Use appropriate information technology for professional and management purposes (e/g/risk analysis
A3	Consider the socioeconomic factors impacting on effective water solutions		**B6**	Modelling a variety of natural and industrial water systems
A4	Understand the governance and institutional frameworks underpinning water resource management			**Graduate skills**
A5	Acquire in-depth knowledge of water treatment technologies		**C1**	Develop critical thinking and carry out research (e.g. present critically and compare their own views and those that differ from their own (in native language and in English)).
A6	In-depth knowledge of innovative membrane technologies		**C2**	Identify and use various learning sources in students' scientific occupations
A7	Gain knowledge of the necessary theories, mathematical, analytical concepts and models to solve water problems		**C3**	Communicate and negotiate effectively with different stakeholders individually and in-group using verbal, written, and electronic modes of communication (in native language and in English)
A8	Critically evaluate current methods of water (domestic and industrial) treatment		**C4**	Make informed professional decisions based on scientific knowledge and appropriate criteria
	Practical skills		**C5**	Work effectively individually or in groups to accomplish assigned tasks.
B1	Be able to provide technical and managerial input into planning of water projects and facilities (in native language and in English)		**C6**	Develop efficient time management skills
B2	Solve engineering problems through the application of theoretical concepts and practical knowledge in industrial setting		**C7**	Appreciate the social impact of research and practical work in the field of study
B3	Conduct laboratory and field experiments, collect, analyse and interpret data		**C8**	Reflect and evaluate on own learning and evaluate peers in a professional manner