Bauman Moscow State Technical University
Department of Ecology and Industrial Safety

MASTER PROGRAMME
280700.68 "Complex Usage of Water Resources"

PROGRAMME HANDBOOK

Education and Culture
TEMPUS

Programme 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".

In cooperation with:
University of Genoa, Italy
Middlesex University of London, UK
Slovak University of Technology, Slovakia
Ural Federal University, Russia
Tambov State Technical University, Russia
Vladimir State University, Russia

Bauman Moscow State Technical University
2012

University	Bauman Moscow State Technical University, BMSTU, Russian Federation
Programme level	Master level
Status	Joint International Programme
Name of the course	Complex Usage of Water Resources, 280700.68
Field and classification code	Safety in technosphere, 280700
Qualification	Master of Engineering and Technology
Web-site	http://mhts.ru/about/International_eng.asp
Department	Faculty of Power Engineering, Department of Ecology and Industrial Safety
Address	105005, Russian Federation, Moscow, 2-nd Baumanskaya, building 5, BMSTU, Department of Ecology and Industrial Safety
Course length	2 years
Workload	120 credits (ECTS), 4212 academic hours
Start date	October 2010
Professional recognition	AKKORK, Agency for Higher Education Quality and Career Development
Teaching organization	Semester modules, lections, laboratory works, individual work, scientific supervising, master thesis preparation
Mode of study	Full-time
Language of study	Russian and English
Professional recognition	The following stakeholders have been consulted for the designing of the Course programme: Department for Environmental Protection and Natural Resources, Ministry of Education and Science of RF, Education and Methodological Association on Engineering specialties
Teaching organization	Semester modules, front lessons, field trips, laboratory works, individual work, scientific supervising, master thesis preparation

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1. Criteria for Admission to the Programme

Applicants should normally comply with one of the following:

1. Russian and Foreign applicants having a relevant Bachelor or Specialist degree in one of the directions of BMSTU, preferably in some aspect of environment engineering. An equivalent qualification if it will be accepted by the Academic registry of the University.
2. Foreign citizens in the frames of international agreements and contracts with universities, institutions and companies with equivalent first cycle degree qualification.

Applicants having BMSTU Bachelor degree in environment engineering are admitted on competetive basis according to the results of the Bachelor final paper defense.

Applicants with other degrees are admitted on a competetive basis according to their individual application and results of admission tests. Applicants need to be computer literate, have relevant industrial experience and demonstrate high level of interest in the environment protection. The Admission's Office makes the desicion about admission after examing documents and after admission tests. Members of the Admission Office are appointed by the order of BMSTU rector according to the state standards to bachelor training in directions corresponding to master direction.

Admission Tests for Applicants to the Master Programme

1. For Bachelors degree in environment engineering diploma with honors:
   - An interview on the topic of the chosen master programme with the grade scale «pass-fail».

   An applicant is admitted when results are positive. In case of failure an applicant follows the procedure described under point 2.
2. For Bachelors degree in environment engineering diploma with the average grade in the diploma supplement no less than 4,5:
   - An interview within the specialization («pass-fail»).
   - An interview on the topic of the chosen master programme («pass-fail»).

   An applicant is admitted when results are positive. In case of failure an applicant follows the procedure prescribed under point 3.
3. For Bachelors degree in environment engineering diploma with the average grade in the diploma supplement less than 4,5:
   - An examination in speciality: The tests consist of 4 questions: 2 general questions in speciality and 2 questions on the topic of the chosen master programme, each answer is estimated according to five mark grading system, then all grades are summed up.
   - An interview on the topic of the chosen master programme estimated according to five marks grading system.
   - Grade for the final qualification project.

   An applicant will have additional grades for publications if any (Abstract +1, article +3, diploma or Certificate of Merit for scientific or qualification project +1,+3).
4. For applicants having Bachelor or Specialist degree on other directions and specialties:
   - An examination in speciality (The tests consists of 4 questions: 2 general questions in speciality and 2 questions on the topic of the chosen master programme, each answer is estimated according to five mark grading system, then all grades are summed up).
   - An interview on the topic of the chosen master programme estimated according to five mark grading system.
   - Average grade in the Diploma Supplement to Bachelor or Specialist diploma.

   An applicant will have additional grades for publications if any (Abstract +1, article +3, diploma or Certificate of Merit for scientific or qualification project +1,+3).

2. Aims of the Programme

This programme aims to provide scientific knowledge and technological skills on purification, management and use of water. The Master programme develops experts with in-depth knowledge and practice skills in the field of water treatment by traditional processes as well as innovative membrane technologies, which can be used to improve water resource quality. Graduates will gain from this programme expertise in sustainable development of water resources, with specific reference to the making usable, reclaimable and recyclable for domestic, industrial and agricultural use of water, independently from the original sources features. The Programme is labour-market oriented through the focusing on the management of purification treatments, water reclamation and potabilization. The study programme is designed on the basis of integration of consolidated technical and scientific knowledge and applied aspects of innovative research. The Programme 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, and laboratory activities.

In summary this programme aims to:

- provide an intellectual challenge to develop skills and personal qualities to promote self confidence in the field of environmental study;
- enable students in reaching their maximum potential through the provision of an appropriate level of academic support to meet professional learning outcomes;
- provide professional training to enable students to respond to present and future environmental needs;
- encourage autonomous learning skills and a commitment to life-long learning;
- give students an understanding of theories and principles of waste water treatment;
- enable students to further their personal and professional development.

3. Programme Outcomes

A. Knowledge and understanding	**Teaching/learning methods**
On completion of this programme the successful students will be able to: 1. Present critically and compare their own views and those views that differ from their own. 2. Select appropriate setup treatment facilities. 3. Identify the purposes of various unit processes. 4. Compare and contrast the major physical, chemical and biological characteristics of fresh and waste water, and explain their effects on aquatic organisms. 5. Discuss and evaluate the options available for reuse or disposal of allied residuals. 6. Explain theories of operation of treatment equipment	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. Identify and use various learning sources in students' scientific occupations 2. Model different environmental objects 3. Retrieve, evaluate and use contemporary information 4. Observe and compare different treatment facilities. 5. Compute water treatment plants characteristics 6. Apply theoretical concepts and practical knowledge on site. 7. Plan water treatment systems 8. Design treatment facilities 9. Design other supplementary infrastructures	**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 1. Communicate effectively with diverse stakeholders individually and in-group using verbal, written, and electronic modes of communication. 2. Work effectively individually or in groups to accomplish assigned tasks. 3. Develop an efficient time management skills 4. Carry out researches 5. Develop problem-solving skills	**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 by dissertation module, laboratory reports, essays, group project and data analysis assessment.

4. Programme Structure

The award of MSc of Engineering and Technology in Complex Usage of Water Resources will be made on completion of 14 taught modules (9 compulsory and 5 out of 7 elective, 5 or 10 ECTS credits each depending on the module) and on successful completion of approved practical experience (30 ECTS credits) – i.e. gaining 120 ECTS credits
The programme starts in October.

The structure of the full-time programme is:

1st year				***2nd year***		
1 term		***2 term***		***3 term***		***4 term***
Name	***ECTS***	***Name***	***ECTS***	***Name***	***ECTS***	
CUWR-IT	5	CUWR-MB	5	CUWR-PH	5	MSc project 25 ECTS
CUWR-EN	5	CUWR-WW	10	CUWR-ST	5	
Elective course 1	5	CUWR-MP	10	Elective course 4	5	
Elective course 2	5	Elective course 3	5	Elective course 5	5	
CUWR-CS – 25 ECTS (elective)						

Elective courses are:

- CUWR-WD Contemporary Water Disinfection Systems – 5 ECTS
- CUWR-HC Hydrocyclones – 5 ECTS
- CUWR-IE Ion Exchange treatment – 5 ECTS
- CUWR-FL Flotation – 5 ECTS
- CUWR-WH Water Hydraulics – 10 ECTS
- CUWR-WE Water ecology and human impact – 5 ECTS
- CUWR-MA Monitoring and Analytical Control of Water – 10 ECTS

A student must complete all 9 compulsory and 5 elective modules before proceeding to the MSc project.

5. Practical Experience Characteristics (CUWR-CS)

For a successful completion of the Programme a sum of 90 ECTS is needed in total. Therefore Approval practical experience (CUWR-CS) is not obligatory but recommended. The placement may be found by the student himself. In case of registration to this module the University will provide all necessary assistance with the practical experience. Successful completion of this module results in 30 additional ECTS, gaining all together 120 ECTS.

Development of an original subject by practical experience carried out in industries, public authorities involved in environmental issues and policies, public research labs, university labs, under the guidance of a university supervisor. This practical experience will be focused on the solving of problems linked to the water control and treatment and to the using of membrane processes separation for removing of pollutants coming from anthropic activities and natural events.

6. Information about Assessment Regulations

Each module is separately assessed, with the mode of assessment reflecting the learning outcomes for the particular modules. Students must pass all the components of each module. The final mark of each module will be an aggregate of all the passed components. Modules on the programme cannot be compensated.

The assessment breakdown for each module is as follows:

Code	Name of the module	Assessment
CUWR-IT	Computer Technologies in Research and Education	100 % (20% attendance + 80 % exam)
CUWR-EN	English language	100% (20% attendance + 80% exam)
CUWR-MB	Microbiology and Biotechnology	100% (20% attendance + 80% exam)
CUWR-WW	Water and Waste Water Treatment Processes	100% (20% attendance + 80% coursework)
CUWR-MP	Membranes and Membrane Processes	100% (20% attendance + 40% coursework + 40% exam)
CUWR-PH	Philosophy and Methodology of Science	100% (20% attendance + 20% essay + 60% viva voce)
CUWR-ST	Sludge Treatment Methods	100% (20% attendance + 80% exam)
CUWR-CS	Approved Practical Experience	100% (30% attendance + 70% coursework)
MSc project	Master Thesis Project	100% (80% dissertation + 20 % viva voce)
Elective courses		

SUWR-WD	Contemporary Water Disinfection Systems	100% (20% attendance + 80% exam)
CUWR-HC	Hydrocyclones	100% (20% attendance + 80% exam)
CUWR-IE	Ion Exchange Treatment	100% (20% attendance + 80% exam)
CUWR-FL	Flotation	100% (20% attendance + 80% exam)
CUWR-WH	Water Hydraulics	100% (20% attendance + 80% exam)
CUWR-WE	Water ecology and human impact	100% (20% attendance + 80% exam)
CUWR-MA	Monitoring and Analytical Control of Water	100% (20% attendance + 80% exam)

Grades are awarded on the standard University scale of 2-5, with 5 being the highest. To pass a module all components, attendance, coursework, examination, dissertation must be passed individually with a minimum grade of 3.

7. Placement Opportunities, Requirements and Support

The majority of the graduates find their work places in the following industries: chemical, pharmaceutical, food, and textile industry. In all of them people are placed in the areas of production, research and quality control processes.
In addition, a number of placements are available in public authorities involved in environmental issues and policies.
Water treatment and membrane technologies are closely linked to the industrial process of separation (food, chemistry, iron & steel ones), therefore students who have chosen this module could work in these areas also.
Last but not the least, some places available for graduates as industrial consultants for health and safety in the workplaces.
Based on the experience of the Department it is expected that over 80% of the graduates have found employment in the area of complex usage of water resources.
Over 10% of students pursue further postgraduate study or research.
Feedback from past students all agreed that this programme has helped them in their career development.

8. Module Narratives

The programme consists of 9 compulsory modules (including approved practical experience and master thesis project) and 7 elective modules. Five out of seven elective modules have to be selected by the sudent.

Compulsory courses

Module 1

Title	Philosophy and Methodology of Science
Code	CUWR-PH
Credit point / total ac. hours	5 / 136
Module leader	Kuznetsov E.N., Dept. of Philosophy, Faculty of Social and Humanitarian Sciences.
Prerequisites	-
Start term	3
Aim of the module. To enable students to reach a high level of skill in various disciplines, to prepare them for further research and scientific studies, to provide students with knowledge of ancient and modern philosophy, its relationship with science and its possible uses in scientific occupations.	
Lectures, ac. hours	34
Laboratory or practical studies, ac. hours	00
Individual work, ac. hours	102
Learning outcomes After studying this module students should: *Knowledge and understanding:* - present critically, philosophical views that differ from their own. - be competent in formal techniques, including, but not limited to, formal logic, ancient and modern philosophy - associate relationship of philosophy with science *Practical skills:* - use these methods in their scientific occupations	

Module 2

Title	Computer Technologies in Research and Education
Code	CUWR-IT
Credit points	5 / 204
Module leader	Plastinin Yu.V. Dept. of Programming and Information Technologies, Faculty of Informatics and Control Systems.
Prerequisites	-
Start term	1
Aim of the module Provide students with knowledge of modern informational technologies used in engineering applications, and with skills necessary to use those technologies. To equip students with knowledge to enable them to develop and apply new computer technologies in various disciplines. Provide cutting-edge methodology in IT industry necessary enough to carry out research projects	
Lectures, ac. hours	68
Laboratory or practical studies, ac. hours	68
Individual work, ac. hours	68
Learning outcomes After studying this module students should: *Knowledge and understanding:* - recognise software that is necessary for carrying out research - point out information with the help of maps, structure geographical data,	

Practical skills:
- model different environmental objects,
- develop geodatabases,
- design different infrastructures,
- raster and vector data.

Module 3

Title	English Language
Code	CUWR-EN
Credit points	5 / 170
Module leader	Verbitskaia V. D., Dept. of English language, Faculty of Linguistics.
Prerequisites	-
Start term	1

Aim of the module
The module aims giving the possibility to a student to fluently read scientific articles and literature on English, be able to write his or her own article in English, feel free in communicating with others from the scientific society. This is done through constant improving student's English language skills in areas of speaking, writing, reading and listening.

Lectures, ac. hours	00
Laboratory or practical studies, ac. hours	68
Individual work, ac. hours	102

Learning outcomes
After studying this module students should:
Knowledge and understanding:
- Show confidence in verbal communications in English in a variety of topics and themes;

Practical skills:
- Translate technical and scientific texts from English to Russian and from Russian to English;
- Use English language to express ideas, proposals and technical suggestions.

Graduate skills:
- Communicate easily in English
- demonstrate ability to clearly present and discuss conclusions on the degree project in writing and orally in English
- critically examine and oppose on another student's degree project

Module 4

Title	Microbiology and Biotechnology
Code	CUWR-MB
Credit points	5 / 170
Module leader	Ksenofontov B. S.
Prerequisites	-
Start term	2

Aim of the module
The module aims giving a thorough understanding of the cell structure, knowledge of microorganisms'' interaction with the environment and with human beings. Furthermore, students will be able to define and characterize different types of microorganisms, s
Providing students with basic knowledge of biotechnology and microbiology, such as bacteria, viruses etc and classify them according to the appropriate standards. Besides, these knowledge will be extended on the biotechnological processes in order to let students good understanding of

how microbiological methods of wastewater treatment are carried out.	
Lectures, ac. hours	34
Laboratory or practical studies, ac. hours	00
Individual work, ac. hours	136

Learning outcomes

After studying this module students should:

Knowledge and understanding:

- Demonstrate knowledge of cell structure and metabolism;
- Demonstrate knowledge of how microorganisms interact with their environment;
- Understand the role, the kinetics and the factors affecting the performance of microorganisms in a particular biological treatment process.

Practical skills:

- Describe and use new and existing methods and technologies in and out the laboratory setting.
- Retrieve, evaluate and use contemporary microbiologic information;
- Evaluate and apply the proper methods of microbial control necessary in sample scenarios or case studies.

Module 5

Title	Water and wastewater treatment
Code	CUWR-WW
Credit points	10 / 300
Module leader	Pavlikhin G. P.
Prerequisites	-
Start term	2

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, ac. hours	51
Laboratory or practical studies, ac. hours	68
Individual work, ac. hours	181

Learning outcomes

After studying this module students should:

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 6

Title	Sludge Treatment Methods
Code	CUWR-ST
Credit points	5 / 136
Module leader	Ksenofontov B.S.
Prerequisites	Completion of CUWR-ST
Start term	3

Aim of the module

This module aims enhancing students' knowledge and understanding of wastewater treatment processes. Particularly this module addresses wastewater sludge treatment methods. In this module all necessary equipment will be studied and students will be taught how to design, install and maintenance sludge treatment facilities. They will be able to distinguish nitrification and de-nitrification, identify specific bacteria necessary for these processes and know factors that may negatively affect on the treatment process.

Lectures, ac. hours	17
Laboratory or practical studies, ac. hours	00
Individual work, ac. hours	119

Learning outcomes

After studying this module students should:

Knowledge and understanding:

- Review the chemical and microbiological characteristics and composition of sludges
- Evaluate the technologies that are available for stabilization and treatment of the sludges

Practical skills:

- Be able to match plant with requirements.
- Discuss and evaluate the options available for reuse or disposal of sludges and other allied residuals.
- Be able to choose and design sludge treatment systems.

Module 7

Title	Membranes and membrane processes
Code	CUWR-MP
Credit points	10 / 250
Module leader	Grechuskin A.N.
Prerequisites	CUWR-MP
Start term	2

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, ac. hours	51
Laboratory or practical studies, ac. hours	51
Individual work, ac. hours	148

Learning outcomes

After studying this module students should:

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.

Module 8

Title	Approved Practical Experience
Code	CUWR-CS
Credit points	25 / 1793

Module leader	Smirnov S. G.
Prerequisites	-
Start term	1
Aim of the module Students will be attached to industrial organizations / research centers / university laboratories. This is to prepare them for future employment in their particular discipline of study. 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. It is a valuable part of the academic experience because it gives students an opportunity to: - apply classroom knowledge and skills, - gain valuable work experience that complements the student's academic program, - identify alternative career opportunities, - understand expectations for professionals in the field, - make connection with professionals who might provide letters of recommendation or help with job searches	
Lectures, ac. hours	00
Laboratory or practical studies, ac. hours	222
Individual work, ac. hours	1571
Learning outcomes After successfully completing of approved practical experience students should: *Practical skills:* - Apply theoretical concepts and practical knowledge of previous studies. *Graduate skills:* - Communicate effectively with diverse stakeholders individually and in-group using verbal, written, and electronic modes of communication. - Work effectively individually or in groups to accomplish assigned tasks.	

Module 9

Title	Master Thesis Project
Code	MSc Project
Credit points	25 / 1250
Module leader	Pavlikhin G.P.
Prerequisites	Successful completion of 8 compulsory and 2 out of 5 elective modules
Start term	4
Aim of the module The objective is for the students to demonstrate their mastery of the skills listed below: - ability to formulate, delimit, and operationalise a broadly defined ecological and social problem. - ability to select, discuss and apply theoretical approaches and practical solutions that are applicable in the frames of the given problem of water / waste water pollution. - ability to explain and substantiate the proposed treatment technique and account for its strengths and weaknesses. - ability to present the thesis statement and its clarification in a clear, rational, and grammatically correct manner.	
Lectures, ac. hours	00
Laboratory or practical studies, ac. hours	200
Individual work, ac. hours	1050
Learning outcomes	

After successfully completing of approved practical experience students should:

Knowledge and understanding:

- systematically integrate knowledge acquired during the studies
- demonstrate knowledge and understanding in the main field of study, including both broad knowledge in the field and substantially deeper knowledge. Demonstrate deeper methodological knowledge in the main field of study.
- be able to assimilate the contents of the relevant literature and relate their work to this

Practical skills:

- plan, implement and document an independent degree project
- formulate issues, plan and carry out advanced tasks within specified time limits
- find and evaluate literature

Graduate skills:

- demonstrate ability to clearly present and discuss conclusions on the degree project in writing and orally
- critically examine and oppose on another student's degree project

Elective Courses

Module 1

Title	Contemporary Water Disinfection Systems
Code	SUWR-WD
Credit points	5 / 136
Module leader	Nosenko V.A.
Prerequisites	-
Start term	3
Aim of the module The module will prepare students for the operation and maintenance of water and wastewater disinfection systems. The installation of the equipment required by these systems will be explored. Specific accent will be made on disinfection by chlorination (calculations of chemical dosages will be taught) and UV disinfection (necessary equipment will be studied).	
Lectures, ac. hours	17
Laboratory or practical studies, ac. hours	00
Individual work, ac. hours	119
Learning outcomes After studying this module students should: *Knowledge and understanding:* - Identify between collection and disinfection systems - Identify and explain the equipment and uses of the equipment for water disinfection. *Practical skills:* - Obtain proficiency with analytical methods used for disinfection of waters and wastewaters - Calculate flows, chemical dosages and feed-rates, percent solutions and other mathematical computations associated with chemical additions - Be able to choose and design water disinfection devices.	

Module 2

Title	Hydrocyclones
Code	CUWR-HC
Credit points	5 / 187
Module leader	Lvov V. A.
Prerequisites	-
Start term	1
Aim of the module This module aims enhancing students' knowledge and understanding of water treatment processes. Particularly this module addresses water treatment with the use of hydrocyclones. So, all necessary equipment will be studied and students will be taught how to design, install and maintenance hydrocyclones.	
Lectures, ac. hours	34
Laboratory or practical studies, ac. hours	00
Individual work, ac. hours	153
Learning outcomes After studying this module students should: *Knowledge and understanding:* - Demonstrate an understanding of the detailed design features and operating characteristics of the hydrocyclones	

- Explain theory of operation of hydrocyclones
- Identify and classify types of hydrocyclones

Practical skills:

- Choose and design an appropriate hydrocyclone for a given water treatment plant

Module 3

Title	Water Hydraulics
Code	CUWR-WH
Credit points	10 / 250
Module leader	Borisov B.P., Dept. of Hydraulics, Faculty Power Engineering
Prerequisites	-
Start term	2

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, ac. hours	51
Laboratory or practical studies, ac. hours	34
Individual work, ac. hours	165

Learning outcomes

After studying this module students should:

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.

Skills and competences

- apply engineering processes relevant to the water industry such as : hydraulic calculations; heat calculations;
- collect, process, analyze 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 4

Title	Water ecology and human impact
Code	CUWR-WE
Credit points	5 / 104
Module leader	Kapitonova S. N.
Prerequisites	-
Start term	1

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, ac. hours	34
Laboratory or practical studies, ac. hours	17
Individual work, ac. hours	53

Learning outcomes

After studying this module students should:

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;
- understand 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;
- analyze 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 5

Title	Monitoring and Analytical Control of Water
Code	CUWR-MA
Credit points	10 / 250
Module leader	Pavlikhin G.P.
Prerequisites	-
Start term	2

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, ac. hours	51
Laboratory or practical studies, ac. hours	34
Individual work, ac. hours	165

Learning outcomes

After studying this module students should:

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.

Skills and competences

- 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 skills

- decision making;
- group work;
- manage time;
- carry out research and develop critical thinking.

Module 6

Title	Ion Exchange Treatment
Code	CUWR-IE
Credit points	5 / 187
Module leader	Nosenko V. A.
Prerequisites	-

Start term	1
Aim of the module In this course students will gain knowledge of ion exchange water treatment methods. Specific accent will be made on designing, operating and maintenance treatment units in order to provide safe and aesthetically desirable drinking water supplies.	
Lectures, ac. hours	34
Laboratory or practical studies, ac. hours	00
Individual work, ac. hours	153
Learning outcomes After studying this module students should: *Knowledge and understanding:* - Explain theory of operation for ion exchange units - Identify phases of unit operation *Practical skills:* - Perform basic maintenance activities - Complete troubleshooting analysis - Describe ion exchange water treatment methods. - Choose and design ion exchange units for water treatment.	

Module 7

Title	Floatation
Code	CUWR-FL
Credit points	5 / 187
Module leader	Morozov S. D.
Prerequisites	-
Start term	1
Aim of the module To enable students to collect and analyze laboratory and plant flotation data including size-by-size analysis and describe physical and chemical basis of flotation. Students will be provided with knowledge of - different floatation water treatment methods, - principles of physical aspects of flotation processes, - principles of adsorption of reagents and associated aqueous phase reactions including the role of pulp potential - calculation methods for the mass balance for water, solid, elements and minerals in a laboratory flotation test and a plant survey	
Lectures, ac. hours	34
Laboratory or practical studies, ac. hours	00
Individual work, ac. hours	153
Learning outcomes *Knowledge and understanding:* - Identify and classify flotation water treatment methods. - Explain physical and chemical principles on which flotation process is based. - Identify phases of flotation treatment. *Practical skills:* - Conduct a series of laboratory flotation tests. - Choose and design appropriate flotation tanks for water treatment	

9. List of the teaching staff

Name	Degree*	Position in BMSTU, Department of Ecology and Industrial Safety unless other is stated	Task
Borisov B. P.	Sc. Dr. Eng.	Professor Dept. of Hydraulics, Faculty Power Engineering	Module leader
Ivanov M. V.	Dipl. Eng.	Assistant lecturer	Module leader Assistant to prof. Pavlikhin Curriculum and timetable compilation
Ksenofontov B. S.	Sc. Dr. Eng.	Professor	Module leader
Kuznetsov E.N.,	Dipl. Eng.	Assistant lecturer Dept. of Philosophy, Faculty of Social and Humanitarian Sciences.	Module leader
Lvov V. A.	Dipl. Eng.	Senior lecturer	Module leader
Morozov S. D.	Dipl. Eng.	Assistant lecturer	Module leader Assistant to prof. Pavlikhin Curriculum and timetable compilation
Nosenko V. A.	Dipl. Eng.	Senior lecturer	Module leader
Pavlikhin G. P.	Sc. Dr. Eng.	Head of the Departmemt, Professor	Project leader Module leader
Plastinin Yu.V.	Dipl. Eng.	Senior lecturer Dept. of Programming and Information Technologies, Faculty of Informatics and Control Systems.	Module leader
Verbitskaia V. D.,	Dipl. Eng.	Senior lecturer Dept. of English language, Faculty of Linguistics.	Module leader

*Sc. Dr. Eng. – Doctor of Science in Engineering; Ph. D. Eng. – Philosophy Doctor of engineering sciences; Dipl. Eng. – Diploma in Engineering.

9. Recommended literature

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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.
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8. Forecasting of Hydrogeological Circumstances Changes under the Influence of Water-related Activities. – M.: Nedra, 1987.-205 p.
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14. Malygin E.N., Popov N.S. Informat ion Analysis and Co mputer-aided Design o f Biological Treatment Stations. Tambov, TSTU, 2004.- 120 p.
15. Mur Jh. V. Heavy Metals in Natural Water. - M.: Mir, 1987.-286 p.
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20. Poyta L.L., Novoceltsev V.G., Kovalchuk V.L., Golovach T.I. Municipal Waste Disposal Plant. Brest, 2004.-118 p.
21. Proskuryakov V.A., Shmidt L.I. Wastewater Purification in Chemical Industry.- L.: Chemistry, 1977.-464 p.
22. Quality Forecasting of Ground Waters Protected from Pollution. - M.: Nauka, 1978.-208 p.
23. Rodziller I.D. Forecasting of Water Volume/Amount in Wastewater Reservoir . – M.: Stroyizdat, 1984.-263 p.
24. Smirnov D.N., Dmitriev A.S. Automation of Wastewater Purification Processes in Chemical Industry. - L.: Chemistry, 1981.-198 p
25. Strashcraba M., Gnauk A. Freshwater Ecosystems. Mathematical Modeling. - M.: Mir, 1989.-377 p.
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26. Tregubenko N.S. Water Supply and Water Drainage. Calculation Examples. - M.: Higher School, 1989.-352 p.
27. 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.

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10. Curriculum map for MSc Complex Usage of Water Resources

Module	Code	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	B8	B9	C1	C2	C3	C4	C5
Computer Technologies in Research and Education	CUWR-IT	√						√	√	√		√			√	√	√	√			
English Language	CUWR-EN							√		√							√	√	√		
Microbiology and Biotechnology	CUWR-MB			√	√				√		√			√	√						
Water and Waste Water Treatment Processes	CUWR-WW		√	√	√	√	√		√		√	√		√	√					√	
Philosophy and Methodology of Science	CUWR-PH							√		√						√	√	√	√		
Monitoring and Analytical Control of Water	CUWR-MA			√	√	√	√		√		√	√		√		√					
Water ecology and human impact	CUWR-WE	√	√					√		√			√				√				√
Sludge Treatment Methods	CUWR-ST			√	√		√		√		√	√		√	√						
Contemporary Water Disinfection Systems	SUWR-WD			√	√	√	√		√		√	√		√		√					
Hydrocyclones	CUWR-HC			√			√		√		√	√	√			√		√			
Ion Exchange treatment	CUWR-IE			√		√	√		√		√	√	√			√		√			
Flotation	CUWR-FL			√			√		√		√	√	√			√		√			
Membranes and membrane processes	CUWR-MP			√		√	√		√		√	√	√		√			√		√	
Water Hydraulics	CUWR-WH						√		√	√					√			√			
Approved Practical Experience	CUWR-CS							√	√	√			√	√	√	√	√	√	√	√	√
Master Thesis	MSc project							√		√			√	√	√	√	√	√	√	√	√

Programme outcomes:

	Knowledge and understanding
A1	Present critically and compare their own views and those that differ from their own.
A2	Identify the setup treatment facilities
A3	Identify the purposes of various unit processes.
A4	List and describe the major physical, chemical and biological characteristics of fresh and waste water, and explain their effects on aquatic organisms.
A5	Discuss and evaluate the options available for reuse or disposal allied residuals
A6	Explain theory of operation of treatment equipment
	Cognitive skills
B1	Identify and use various learning sources in students' scientific occupations
B2	Model different environmental objects
B3	Retrieve, evaluate and use contemporary information
B4	Observe and compare treatment facilities
B5	Compute water treatment plants
B6	Apply theoretical concepts and practical knowledge on site
B7	Plan water treatment systems
B8	Design treatment facilities
B9	Design other supplementary infrastructures
	Graduate skills
C1	Communicate effectively with diverse stakeholders individually and in-group using verbal, written, and electronic modes of communication
C2	Work effectively individually or in groups to accomplish assigned tasks
C3	Develop an efficient time management skills
C4	Carry out researches
C5	Develop problem-solving skills