MASTER STUDY-PROGRAMME IN INNOVATIVE TECHNOLOGIES FOR ENERGY SAVING AND ENVIRONMENTAL PROTECTION «GREEN MASTER»

DEVELOPED IN THE FRAMEWORK OF THE

TEMPUS PROJECT 530620-TEMPUS-1-2012-1-IT-TEMPUS-JPCR "LLL TRAINING AND MASTER IN INNOVATIVE TECHNOLOGIES FOR ENERGY SAVING AND ENVIRONMENTAL CONTROL FOR RUSSIAN UNIVERSITIES, INVOLVING STAKEHOLDERS - GREENMA"

PROGRAMME HANDBOOK

in cooperation with

D. Mendeleyev University of Chemical Technology of Russia
Ivanovo State University of Architecture and Civil Engineering
Ivanovo State University of Chemistry and Technology
North Ossetian State University in Vladikavkaz
Perm National Research Polytechnic University
Stavropol State Agrarian University
Tambov State Technical University
Tyumen State University of Architecture and Civil Engineering
Ural Federal University n.a. Boris Eltsin, Yekaterinburg
Vladimir State University n.a. Stoletovs
Voronezh State University of Architecture and Civil Engineering

and

City University of London, United Kingdom
Silesian University of Technology in Katowice, Poland
Universidad de Alicante, Spain
University of Genova, Italy

STAVROPOL STATE AGRARIAN UNIVERSITY

2014

University	**Stavropol State Agrarian University,SSAU, Russia**
Programme level	**Master level**
Status	**Joint International Programme**
Name of the course	"Innovative Technologies for Energy Saving and Environmental Control for Russian Universities, involving Stakeholders GREEN MASTER" 022000.68 (Russian education classification code)
Field and classification code	**"Ecology and Environmental Management"** **022000 (Russian education classification code)**
Qualification	**Master of Environmental Sciences**
Web-site	**http://www._____ _____**
Faculty	**Agronomy and plant protection**
Address	**str, Zootechnichesky 12, Stavropol, 355017, Russia**
Course length	**2 years**
Workload	**120 credits (in accordance with ECTS)** **4320 academic hours (in accordance with Russian education standard)**
Start date	**September 2014**
Professional recognition	**Stakeholders consulted for the designing of the study-programme:** **Institute of Energy Saving of Sverdlovsk Oblast, Yekaterinburg** **Federal Service on Customers' Rights Protection & Human Well-Being in Vladimir** **Union of Constructors of Sverdlovsk Region, Yekaterinburg** **Tambov Regional Administration** **Energomera JSC in Stavropol**
Teaching organization	**Semester modules, front lectures, field visits, laboratory works, individual work, scientific supervising, Master thesis preparation.**

Preliminary statement:

The process of introducing the two-level education system in the Russian Federation results in changing the workload unit. These measures are settled in order to harmonize the Russian Federation academic systems with the European ones. The term "Russian credit unit" (RCU), in Russian "Zachetnaya edinitsa" ("Passing unit") was introduced for the State Education Standard of the Third generation developed in recent years. One RCU is considered equal to 1 ECTS credit unit. Now the workload of:
Master programme -120 RCU
Bachelor programme -240 RCU
Specialist programme – 300 RCU

Aims of the programme:

The programme GREEN MASTER proposes a combined approach of environmental protection and control with the ecology and technology management of energy and sustainability issues.
The master programme in Energy Saving and Environmental Protection and control is a program that proposes a multi-disciplinary educational approach to train next-generation managers and professionals interested in leading the change towards a sustainable future.
The programme final aim is the harmonization of academic approaches to Energy Saving for environmental protection and control by means of analysis and best practices, building a system of socially and professionally resilient and competitive specialists.

Programme languages: Russian and English

Admission criteria:

- **Bachelor or Specialist degree** in a relevant branch of Science or Engineering, with specific reference to Ecology and Environmental Management; work experience in the field is appreciated.
- **English language** (to be assessed by an interview).
- **Foreign** candidates are required to have the certificate of Russian language course attendance.

Teaching methods
The teaching process will consist of 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, with specific reference to:

1. Tuning methodology
2. Dublin descriptors
3. ECTS

In accordance with the "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-mentioned guidelines, the study-programme will develop the following competences (or generic skills):

The programme graduates will be able to evaluate and solve main social, engineering and environmental problems which may occur in the real life.

- Ability to develop the common cultural and professional level and independently develop new research methods
- Ability to change the field of professional activities
- Ability to independently acquire and use new knowledge and skills
- Ability to make organizational and managerial decisions and assess their effect
- Fluency in a foreign language as a means of professional communication
- Skills in public business and scientific communications
- Knowledge of economic laws of energy saving

Programme structure

Compulsory subjects

- Modern «Green» protection and energy saving technologies
- Introduction to thermodynamics of open systems: balance energy flows and substances in biosphere
- Practical using and methods of optimization of energy and resource saving technological systems
- Energy saving and ecological audit
- Modeling of Technological and Ecosystems
- Energy and environmental management
- Environmental Safety and Energy Sustainable Development
- English Language for Environmental Studies
- Monitoring of natural and technogenic systems

Elective subjects

- Organic agriculture
- Environmental -monitoring laboratory
- Ecological reconstruction of rural areas

Practical Research

Master Thesis

Programme Outcomes

A. Knowledge and understanding	Teaching/learning methods
1. To know the basic rules and trends of energy safety and environmental protection, thermodynamics, exergy analysis 2. To know and understand organizational and legal activities for energy saving and environmental management 3. To know and understand the methods of economic and strategic analysis of behavior of economic agents and markets of global environment 4. To understand the modern methods of corporate financing with strategic goals 5. To understand the role of effective innovative technologies in the sphere of energy saving and environmental protection 6. To understand quantative and qualitative methods for research and management 7. To know the types of models, to understand the possibilities of mathematical modeling 8. To understand the results obtained by national and foreign researchers, to understand the scientific	Students gain knowledge and understanding through attendance in lectures, seminars and laboratories, problem solution classes, laboratory classes, internships, mobilities, field practice, e-learning **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	Teaching/learning methods
1. Be able to provide technical and managerial input into planning of energy saving projects and facilities (in native language and in English) 2. Conduct laboratory and field experiments, collect, analyse and interpret data 3. Select and use appropriate methods and technologies for solving practical tasks 4. Use appropriate information technology for professional and management purposes in the sphere of energy saving and environmental protection 5. Modelling a variety of natural and industrial systems 6. Complex researches of branch, regional, national and global ecological issues in the sphere of energy saving and environmental protection, to develop the guidance for their solution	Students learn cognitive skills through attendance in seminars and laboratories, research supervision, practices, creative workshops, problem solution classes, case study analysis, internships, mobilities, field practice, e-learning **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

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 attendance in seminars and laboratories, research supervision, practices, creative workshops, problem solution classes, case study analysis, internships, mobilities, field practice, e-learning **Assessment method** Students' graduation skills are assessed by dissertation module, laboratory reports, essays, group project and data analysis assessment.

COMPULSORY SUBJECTS

Module 1 Title	**Modern «Green» protection and energy saving technologies**
Credits	6 ECTS credits, 216 academic hours
Module leader and assistant (if any)	V. Ya. Khorolsky, Doctor in Technical Sciences, Professor V. N. Shemyakin Ph.D. in Technical Sciences, Docent
Study terms	Year 1, semester 1, Year 1, semester 2.

Aim of the module

This module makes possible to introduce to the students examples of renewable energy production (wind and sun energy, bio fuel, etc.), rise of traditional fuel efficiency, improvement of energy consumption systems, residential spheres and other trends of human household activity. These, above all include "green technologies" (environmentally friendly) aiming at decrease of negative effect on environment by means of decreasing wastes, reduction of resources consumption, substitution of toxic and dangerous materials by non-toxic and low-hazard ones, etc.
Including this module into the master programme let teaching the methods of general environmental wastes management, land recreation, prevention of air, water and soil pollution by means of ecodesign.
The study of materials of the present module allows the master students to acquire new knowledge in the field of ecodesign and to be ready to take part in fundamental transformation of global economics.

Lectures	54 hours
Laboratory works	54 hours
Individual work	108 hours

Learning outcomes

Knowledge and understanding:

- Gain knowledge of methodology of complex macrosystems research
- Gain in-depth knowledge of strategic policies of Russia in environmental and economic development sphere
- Understand significance of innovation technologies for power economy modernization in the country
- Understand causes of industrial low efficiency
- Acquire knowledge of control means for natural environments quality
- Study "Green technologies" opportunities

Practical skills

- Search for information and substantiation of standard engineering equipment choice
- Evaluate environmental risks
- Calculate energy and material balances
- Evaluate energy consumption level in correspondence to regulations
- Cooperate with different profiles specialists
- Registrate scientific research results
- Choose "green technologies" to improve energy efficiency in industrial systems

Graduate (or Transferable) skills

- Analyse industrial problems and defects detection in energy and resource efficiency of processes
- Cooperate in interdisciplinary specialists group
- Setting the goals
- Substantiation of research results
- Presentation of research materials
- Group work
- Manage time

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

Module 2 Title	**Introduction to thermodynamics of open systems**
Credits	5,5 ECTS credits, 198 academic hours
Module leader and assistant (if any)	Professor N. I. Kornilov, Doctor in Chemistry
Study terms	Year 1, semester 1. Year 1, semester 2.

Aim of the module

The aims of thermodynamic systems are: functional relations between components of natural and industrial systems; value of mass flows and properties of operational liquids in different parts of the system; levels of energy, and irreversibility; fuel and other resources consumption; interrelations between technical qualities of loss energy. Point where these processes take place and reasons (that help to minimize or to recover them); efficiency of single compounds or the whole system (this knowledge is necessary for evaluation of system productivity and comparison to other systems); harmful impacts of the system on environment (e.g. heat or chemical pollution).
Master students study thermodynamic analysis method, its link with economic indexes of the quality of different engineering systems, which help to compare various variants of energy efficiency solutions. Generally, module materials help the students to develop mathematical models of energy consuming systems and pay their attention to project decisions optimization.

Lectures	46 hours
Laboratory works	52 hours
Individual work	100 hours

Learning outcomes

Knowledge and understanding:

Acquire in-depth knowledge of thermodynamic laws

- Understand energy balances in energy consumption systems analysis
- Understand exergy analysis significance
- Study opportunities of exergy balances and their graphical expression
- Know problem “areas” of energy consumption systems
- Gain Knowledge of methods of exergy calculation
- Understand algorithms of energy efficient solutions search

Practical skills

Analyse structurally engineering systems

- Conduct energy and exergy balances
- Evaluate energy efficiency of certain process units and entire technology
- Define exergy loss
- Evaluate energy life cycle in engineering system

Graduate (or Transferable) skills

- Conduct expert diagnostics of industrial systems considering energy carriers
- Transfer receives results and data
- Make decisions about equipment and measurement methods
- Work in a team
- Define energy saving variants

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

Module 3 **Title**	**Practical using and methods of optimization of energy and resource saving technological systems**
Cource **title**	Geoinformation system of natural and urban landscapes. Methods of optimization of energy and resource saving technological systems
Credits	3 ECTS credits, 108 academic hours
Module leader **and assistant (if any)**	Lysenko I. O. Doctor Biology Sciences, Docent Gudiev O. Yu., Ph.D. in Agricultural Sciences, Docent
Study terms	Year 1, semester 1.

Aim of the module

This module depicts objective demands of the countries in different modern natural and energy sources. They are connected with agricultural and industrial development, residential infrastructure creation, etc. At the basis of these processes EU and Russia realize energy saving strategies.

Master students acquire knowledge of the global problems of energy generation, transportation and using recycling energy in different spheres of human activity; realize the necessity of "green technologies" application to increase energy efficiency of natural and industrial systems.

Master students face the problems of sustainable energy and environment management of NIS in regular and special situations, examples are given. They gain the knowledge of a single scientific approach to solve the problems of the study programme.

Lectures	24 hours
Laboratory works	26 hours
Individual work	58 hours

Learning outcomes

Knowledge and understanding:

- Gain knowledge of methodology of complex macrosystems research
- Understand features of environmental and technogenic system interrelation
- Acquire knowledge of quality indicators of natural and technogenic systems
- To understand the issues of energy saving and environmental protection
- Study features of natural and technogenic mathematical description
- Consider opportunities of mathematical analysis for energy and resource saving problems
- Study geoinformation system of natural and anthropogenic landscapes

Practical skills

- Formalize natural and technogenic management aims
- Evaluate criteria for ecosystems
- Develop structural schemes for natural and technogenic subsystems interaction
- Formalize energy saving and environment safety problems for particular ecosystem
- Define energy and ecology consumption standards

Graduate (or Transferable) skills

- Define research objectives
- Consult in research groups
- Present particular natural and anthropogenic as an object of energy saving
- Analyse the references

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

Module 4 **Title**	**Energy saving and ecological audit**
Credits	3 ECTS credits, 108 academic hours
Module leader **and assistant (if any)**	V. A. Khalyutkin, Doctor in Technical Sciences, Professor V. V. Samoylenko Ph.D. in Technical Sciences, Senior Lecturer
Study terms	Year 1, semester 2.

Aim of the module

The aim of this module is the necessity to introduce to the master students methods of energy resources revision and loss reduction in ecosystem of energy supply with simultaneous environmental control. Traditional energy audit, described in the present module, includes technical investigation, analysis of energy generation and consumption systems efficiency to minimize energy resources consumption. Environmental audit methods are shown in the frames of investment projects and energy saving programmes establishment.

In the process of study of the present module master student acquires knowledge in the sphere of energy and environment audit, as well as skills to work with tools for energy and environment processes control.

Lectures	24 hours
Laboratory works	26 hours
Individual work	58 hours

Learning outcomes

Knowledge and understanding:

- Acquire knowledge of methods of systematic inspection of industries for energy efficiency and environment safety
- Understand energy and ecology audit organizational order
- Gain knowledge of audit conditions
- Gain knowledge of audit tools
- Gain knowledge of regulative indexes of energy consumption
- Understand technologies of energy saving in branches

Practical skills

- Organize energy and ecology audit
- Use properly the audit tools
- Recording/documenting audit results
- Statistical methods of data processing
- Develop recommendations
- Make audit reporting

Graduate (or Transferable) skills

- Define the working team
- Define goals and objectives of energy and ecoaudit
- Plan engineering processes study
- Choose assessment criteria for inspection results
- Prepare presentational materials
- Prepare forms to make the conclusion.

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

Module 5 **Title**	**Modeling of Technological and Ecosystems**
Cource **title**	Mathematical Modeling of Energy Efficient Projects Modeling of Technological and Ecosystems
Credits	5 ECTS credits, 180 academic hours
Module leader **and assistant (if any)**	V. I. Marchenko, Ph.D. in Technical Sciences, Docent E. V. Kulaev, Ph.D. in Technical Sciences, Docent
Study terms	Year 2, semester 3.

Aim of the module

The aim of the present module is to teach master students methods of mathematical modeling of industrial environment systems, their application in optimization of energy efficient and environmentally friendly solutions. In the module structure different mathematical model classes are viewed- determined and probabilistic, linear and non-linear, one- and many-dimensional, stationary and non- stationary. Basing on system analysis principles, material and energy balances, chemistry and thermodynamics laws master students learn how to formulate models demands and later to design them. Apart from this they study numerical methods of model equations solutions (Euler, Runge-Kutta, etc.). Possessing the skill to design mathematical models of technological and environment processes master students can formulate optimization problems for energy effective projects.

Lectures	36 hours
Laboratory works	44 hours
Individual work	100 hours

Learning outcomes

Knowledge and understanding:

- Understand problems energy saving and environment safety problems
- Acquire knowledge of system approach to designing processes models
- Understand model adequacy
- Formulating energy saving tasks

Practical skills

- Set tasks of energy consumption optimization problem
- Conduct nature research at the objects
- Design mathematical models
- Check model conformity with the stated problem
- Search for optimal solution
- Conduct parametrical inedtification

Graduate (or Transferable) skills

- Use constructive approach to engineering problems solutions
- Possess leader qualities
- Cooperate with the service of chief power engineer
- Make decisions

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

Module 6 **Title**	**Energy and environmental management**
Course title	Energy and environmental management
Credits	6 ECTS credits, 180 academic hours
Module leader **and assistant (if any)**	V. A. Khalyutkin, Doctor in Technical Sciences, Professor Mandra J.A. Ph.D. in Biology, Docent
Study terms	Year 1, semester 2. Year 2, semester 3

Aim of the module

The aim of this module is to study the main economic opportunities while projecting and operating an energy and ecology systems. Optimization of technological production. In the process of the module study master students understand the essence of economic analysis of energy processes and economic analysis".

In the course of the module master students study criteria for evaluation of technologies energy efficiency, gain the skills to chose target functions of optimization and learn calculation examples for costs distribution between products in whole productions.

Lectures	36 hours
Laboratory works	44 hours
Individual work	100 hours

Learning outcomes

Knowledge and understanding:

- Gain knowledge of principles of industrial organization and functioning
- Acquire knowledge of methods of productions economic efficiency calculation
- Understand SWOT – analysis of enterprises activity
- Acquire in-depth knowledge of enterprises energy and economic activities
- Understand economical risks of enterprises
- Understand scientific approaches to energy saving problems solutions at enterprises

Practical skills

- Set evaluation criteria choice for energy efficiency of engineering processes
- Calculate energy inputs in monetary estimation
- Analyse costs structure at an enterprise
- Evaluate economic losses after the use of inefficient equipment
- Evaluate innovation solutions costs in power economy modernization
- Evaluate investment risks evaluation

Graduate (or Transferable) skills

- Analyse research results and make new decisions
- Analyse enterprise activity
- Develop strategic recommendations
- Project design
- Team work

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

Module 7 **Title**	**Environmental Safety and Energy Sustainable Development**
Course title	Environmental Safety and Energy Sustainable Development
Credits	10 ECTS credits, 360 academic hours
Module leader **and assistant (if any)**	Prof. N. I. Kornilov, Doctor in Chemistry, Professor E. E. Stepanenko, Ph.D. in Biology, Docent
Study terms	Year 1, semester 2. Year 2, semester 3

Aim of the module

The aim of the present module is to master theoretical knowledge while studying exact examples of how to search for optimal projects solutions which can improve the quality of natural and agriculturall systems operation. These include recycling organic waste of living systems: sustainable approach to organic agriculture, using energy saving technologies for production of secondary energy resources, etc. The most important component of the module is integration of all previously viewed scientific approaches and disciplines in a whole- interdisciplinary problem of energy saving and environment safety.

Lectures	80 hours
Laboratory works	80 hours
Individual work	200 hours

Learning outcomes

Knowledge and understanding:

- Critical understanding of energy saving problems at farmers and agricultural enterprises
- Understand “green” technologies introduction
- Acquire knowledge of system approach to designing processes models
- Understand model adequacy

Practical skills

- Search for analogues of efficient energy consumption world wide
- Analyze agrarian technologies in the frames of sustainable development strategy
- Apply interdisciplinary approach to problem solving

Graduate (or Transferable) skills

- Gain practical experience in energy saving problems solving
- Evaluate perspectives in energy consuming systems development
- Manage complex interdisciplinary projects

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

Module 8 **Title**	**English Language for Environmental Studies**
Credits	3 ECTS credits, 108 academic hours
Module leader **and assistant (if any)**	Kalugina E.N. PhD in theory of language, Docent
Study terms	Year 1, semester 1.

Aim of the module

This is an intensive programme for students for whom English is a second or additional language. This intensive programme can help students to 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 agribusiness and ecological themes.
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	2 hours
Laboratory works	52 hours
Individual work	54 hours

Learning outcomes

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.

Module 9 **Title**	**Monitoring of natural and technogenic systems**
Credits	3 ECTS credits, 108 academic hours
Module leader **and assistant (if any)**	S. V. Okrut, Ph.D. in Biology, Docent
Study terms	Year 1, semester 2.

Aim of the module

The purpose of the module: Masters training in modern methods of integrated geo-environmental and socio-economic research .Analysis of the status and dynamics of the interaction of the environment and society. The module provides knowledge and skills in the field of database management environment based on ecologically sustainable development of the environment and energy saving.

Acquired as part of a master's degree program will allow him to work effectively in the area of government institutions of natural and technogenic systems.

Areas of application received professional knowledge can become environmental policies at the national , regional, local and international level.

Lectures	24 hours
Laboratory works	26 hours
Individual work	58 hours

Learning outcomes

Knowledge and understanding:

- Aability to formulate problems, goals and methods of scientific research ,
- Obtain new reliable facts on the basis of observations , experiments ,
- Using modern methods of processing and interpretation of environmental information for scientific and industrial research;
- Understand ecomonitoring purpose
- Gain knowledge of opportunities and methods of mathematical modeling
- ability to assess the impact of the planned buildings or other forms of economic activity on the environment

Practical skills

- Ability to diagnose problems of nature protection, to develop practical recommendations on conservation and sustainable development;
- Apply environmental control instruments
- Ability to develop an action plan for environmental monitoring for environmental compliance , environmental management of production processes ;
- Ability to develop recommendations for the conservation of the natural environment ;

Graduate (or Transferable) skills

- Classification of optimization problems
- Determination of limitations structure in the process of optimal decisions search
- Substantiation of decisions
- Management of energy saving project performance team

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

ELECTIVE SUBJECTS

Module 10 **Title**	**Organic agriculture**
Credits	3 ECTS credits, 108 academic hours
Module leader **and assistant (if any)**	T. G. Zelenskaya Ph.D. in Biology, Docent
Study terms	Year 1, semester 1. Year 1, semester 2.

Aim of the module

This module depicts objective demands- of the development of EU and Russian market in organic agriculture, establish a system of voluntary certification of organic products, encourage and support the supply and demand of organic food, organic products.

Including this module into the master programme let teaching the following key principles of Organic farming^

- creation of sustainable and balanced agricultural systems, ensuring the rational use of natural resources and the production of safe and healthy food consumers;
- ban on the use of substances and the use of technology , potentially damaging to local ecosystems;
- biodiversity protection of local ecosystems through judicious choice of species and varieties of plants and animals for breeding;
- constant maintenance and improvement of the natural fertility of the soil, as well as the integration of crop and livestock systems .

Lectures	24 hours
Laboratory works	26 hours
Individual work	58 hours

Learning outcomes

Knowledge and understanding:

Gain in-depth knowledge of strategic policies of EU and Russia in Organic farming;

- Understand significance of innovation technologies in agribusiness;
- Consider achievements of modern natural science, physical principles of modern technical devices;
- Gain knowledge of- ecological principles and environmental management

Practical skills

Evaluate environmental risks

- Calculate energy and material balances in agrisystem
- Evaluate energy consumption level in correspondence to regulations
- Cooperate with different profiles specialists
- Registrate scientific research results

Graduate (or Transferable) skills

Analyze organic agricultural problems and defects detection in energy and resource efficiency of processes

- Cooperate in interdisciplinary specialists group
- Substantiation of research results
- Presentation of research materials
- Group work

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

Module 11 **Title**	**Environmental -monitoring laboratory**
Credits	3 ECTS credits, 108 academic hours
Module leader **and assistant (if any)**	Mandra J,A. Ph.D. in Biology, Docent Okrut S. V., Ph.D. in Biology, Docent
Study terms	Year 1, semester 2.

Aim of the module

Environmental monitoring is conducted for quality control of all the components of the biosphere, as well as their changes caused by various anthropogenic causes. Environmental -monitoring laboratory is equipped for the exercises control and supervision over how changing functions and composition of the environmental systems.

Lectures	18 hours
Laboratory works	18 hours
Individual work	72 hours

Learning outcomes

Knowledge and understanding:

- Gain in-depth knowledge of strategic policies of EU and Russia in Environmental -monitoring
- Understand significance of innovation systemes in Environmental -monitoring
- Consider achievements of modern natural science, physical principles of modern technical devices;
- Gain knowledge of- ecological principles and environmental management

Practical skills

- Evaluate environmental risks
- Calculate energy and material balances in Ecosystem
- Cooperate with different profiles specialists
- Registrate scientific research results

Graduate (or Transferable) skills

- Analyze Environmental -monitoring problems
- Cooperate in interdisciplinary specialists group
- Setting the goals
- Substantiation of research results
- Presentation of research materials
- Group work

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

Module 12 **Title**	**Ecological reconstruction of селитебных areas**
Credits	3 ECTS credits, 108 academic hours
Module leader **and assistant (if any)**	O. A. Pospelova Ph.D. in Agricultural Sciences, Docent
Study terms	Year 2, semester 3.

Aim of the module

Дать представление о структуре, компонентах, энергетике и экологических проблемах селитебных территорий и современных подходах к их экологической реконструкции.

Lectures	18 hours
Laboratory works	18 hours
Individual work	72 hours

Learning outcomes

Knowledge and understanding:

- Units of residential areas and sources of their pollution
- Power supply of residential areas and alternative energy saving energetics for populated localities
- Units of ecological management of residential areas,
- Issues of residential areas reconstruction

Practical skills

- Develop recommendations in energy efficiency improvement of reconstruction of rural areas;
- Choose energy saving control and management systems at agricultural enterprise and efficient equipment and control system;
- Use properly computer programmes;
- Make economic assessment of decision-making

Graduate (or Transferable) skills

- Analyze reconstruction of rural areas problems and defects detection in energy and resource efficiency of processes
- Cooperate in interdisciplinary specialists group
- Setting the goals
- Substantiation of research results
- Presentation of research materials
- Group work

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

Module 13 **Title**	**Approved practical research experience**
Credits	1. 23,0 credits, 828 academic hours 2. 10,5 credits, 378 academic hours
Module leader **and assistant (if any)**	all teachers of the programme- scientific supervisors of the master students
Study terms	1. 1st year and 2nd year, 1-3 semesters 2. 1st year and 2nd year, 2 and 4 semesters

Aim of the module

The module will be carried out, in cooperation with a scientific supervisor, stakeholder's organizations, research centres,/ university laboratories during all the study terms. The master will be inserted into research and practical activities, then in employment perspective. The student will undertake projects and tasks assigned by the organizations. This experience will allow to the student the opportunity to take initiatives as well as to develop the self-confidence, interpersonal and adaptation skills.

Learning outcomes

To carry out projects and tasks given by a lead organization during the period of Master's internship. To 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 14

Course title	**Master Thesis**
Credits	30 credits, 1080 academic hours
Module leader **and assistant (if any)**	exact scientific supervisor
Study terms	2nd year, 4th semester

Aim of the module

To master theoretical and practical solution methods of energy saving and environmental safety in complex technological industries and complexes.

Learning outcomes

Preparation of the Master's thesis and final State examination.
Valuable practical results of the Master thesis and their application for the regional economy and the socioeconomic environment.

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 Tempus project Evaluation board
- Students feedback

External

- Evaluation by European academics from partner universities
- Ministry of Education and Science of Russian Federation official recognition (licensing)
- Evaluation by employers

Employment opportunities

Master programme graduates have the opportunity to be employed at power branches of industries, employees of regional administrative authorities in ecology and environmental management, in Environmental monitoring laboratories, scientific and research centres dealing with the problems of energy saving and Environmental protection and control of ecosystems.

Learning resources available at the Chair (bought in the framework of the project)

1. Artamonov V.S. Resource saving technologies of solid waste treatment. – M. Gumanistika. 2008 – 192 p.
2. Drugov Yu. S., Rodin A.A., Muravyev AG. Express analysis of ecological samples. practice guidelines – M. : BINOM. Laboratoria znanyy, 2013. – 424 p.
3. Drugov Yu.S. Monitoring organic environmental pollution. 500 methods: practice guidelines – M.: BINOM. Laboratoria znanyy, 2013 – 893 p.
4. Taratorkin V. M.,. Petrov E. B. Resource saving technologies in dairy farming and fodder production. – M., Kolos, 2009. – 376 p.
5. Environmental monitoring and assessment. Textbook / M.G. Yasoveev, E.V. Kakareka, N.L. Strekha.– M.: Infra-M,Novoye znanye, 2013
6. Methods and devices for environmental control and environmental monitoring. Textbook / A. Z. Vartanov, A. D. Ruban,V. L. Shakuratnik – M.: Gornaya kniga, 2009 – 640 p.
7. Golitsin A.N.Industrial ecology and monitoring environmental pollution. – M. Oniks, 2010. – 336 p.
8. Practical course on agroecology. Textbook. –SPSU Publishing house, 2011 – 148 p.
9. Moscalenko A.P. Environmental and resource saving economics. – M.: Phoenix, 2013. – 478 p.
10. Sidorenko O.D., Kutrovsky V. N. Bioconversion of agricultural wastes. Textbook. – M.: Infa-MYu 2013 – 160 p.
11. Kashkarov A.P. Wastes for income. Rules and projects of lossless management. – 2012. – 152 p.
12. Jesse Russell. Biofuel – VSD, 2012. – 104 p.
13. Jesse Russell. Landfill gas. – VSD, 2013. – 116 p.
14. Jesse Russell. Alternative energetics. – VSD, 2013. – 105 p
15. Shubov L.Ya. et al. Waste technology. Textbook. – M., 2013
16. Borisova M.I. Environmentally safe enterprise operation: features, challenges, perfection. – M.: Vuzovskaya kniga, 2009. – 116 p.
17. Ignatov V.G. Kokin A.V Baturin L.A. Sustainable management of natural resources. – Rostov-on/D: Rostov publishing house, 2012.
18. Resource saving technologies in agribusiness [[Text] :] : Textbook / [I. L. Vorotnikov, K. A. Petrov, E. A. Kotelnikova] ; Ministry of agriculture of the RF, Federal State Budget Educational Institution of Higher Professional Education “Saratov State Agrarian University named after N.I. Vavilov” Saratov : Saratovskyi istochnik , 2013 - 115 p.
19. Resource saving technologies: state, outlook, efficiency [[Text] :] : scientific publication / Ministry of agriculture of the RF, Federal State Budget Scientific Institution “Russian Scientific Research Institution of Information and Technical Economic Research for Engineering and Technical Supply of Agribusiness” (FSBSU "Rosinformagrotekh") ; [E. L. Revyakin et al.] Moscow : Rosinformagrotekh, 2011 - 155 p.
20. Federov O.V. Resource saving in energy supply: monograph / O. V. Federov, N. V. Golubtsov, I. I. Grebenuk. – M.: Infra-M, 2011. – 246 p.
21. Power supply and power saving in agriculture. V. 1. Electrical energy industry, electric engineering, thermal physics and thermal engineering, power saving in engineering and technologies. – 2010. – 168 p.
22. Power supply and power saving in agriculture. V. 2. Energy saving technologies in crop farming and portable energy supply. – 2010. – 330 p.
23. Power supply and power saving in agriculture. V. 3. Energy saving technologies in cattle breeding and stationary energy supply. – 2010. – 340 p.
24. Power supply and power saving in agriculture. V. 4: Renewable power sources. Local power sources. Ecology. – 2010.
25. Power supply and power saving in agriculture. V.5 Nanotechnology and infocommunication technologies. – 2010. – 260 p.
26. Power and resource saving. Issues of ecological safety. – 2010. – 79 p.
27. Environmental monitoring and assessment: textbook for students of Higher Professional Education of “Geography. Nature protection” Faculty / [M. G. Yasoveev et al.] ; edited by M. G. Yasoveev Moscow : INFRA-M ; Minsk : Novoye znanye, 2013 - 303 p.
28. Fedyaeva O. A. Production environmental control : конспект лекций / O. A. Fedyaeva; Feera. Agency for Education, SEI HPE OSTU – Omsk: OSTU Publishing House, 2009. – 50 p.

29. Basics of ecological safety and environmental protection : textbook / G. V. Kozmin [et al.] ; [edited by G. V. Kozmin] ; Ministry of Education and Science of the RF, Federal State Budget Scientific Institution of Higher Professional Education "National Research Nuclear University " MEPhI", Obninsk Institution of Nuclear Energy, Faculty of advanced vocational training and retraining. Obninsk : INTE SRNU MEPhI, 2011 - 151 p.
30. Methods of ecological research and environmental monitoring : Textbook / N. Yu. Polomoshnova, E. V. Konovalova ; Ministry of agriculture of the RF, Department of Scientific and Technological Policy and Education FSBEI HPE "Buryat State Agrarian Academy named after V. R. Filippov" Ulan-Ude : Publishing House of BSAA named after V. R. Filippov, 2013 - 220 p
31. English-Russian Dictionary of Energy and Environmental Protection, 2001 - 776
32. New English- Russian , Russian -English dictionary of technical terms and phrases for Heating, Ventilation , Refrigeration , Air-Conditioning , Heat Supply and Building Thermal Physics

Recommended literature

1. Aquatic ecology and anthropogenic influence on state of water resources: study guide / under general editorship of G. B. Volodina, N. S. Popov. – Tambov : Self-employed publisher A. V. Chesnokova, 2011. – 230 p.
2. Ecomonitoring and analytical control of water quality: study guide / under general editorship of N. V. Yakunina, N. S. Popov. - Tambov : Self-employed publisher A. V. Chesnokova, 2011. – 236 p.
3. Membranes and membrane process : study guide in 2 volumes / under general editorship of Yu. T. Panov, N. S. Popov. – Tambov : Self-employed publisher A. V. Chesnokova, 2011. – 148p.
4. Research methods and project management : study guide / under general editorship of N. S. Popov. – Tambov : Self-employed publisher A. V. Chesnokova, 2011. – 72 p.
5. Natural and waste water treatment. V. 2: Water treatment. Drinking and industrial water treatment : study guide / under general editorship of N. S. Popov. – Tambov : Self-employed publisher A. V. Chesnokova, 2011. – 174 p.
6. Aquatic engineering : hydraulic processes, equipment and control tools : study guide / under general editorship of N. S. Popov. – Tambov : Self-employed publisher G. P. Pavlikhin, 2011. – 128 p.
7. Greening of agriculture (transformation of tradition-bound farming into organic farming) / C. Shchyukin, A. Trufanov et al. / Series of educative handbooks “RUDECO”. Vocational Training in Rural Development and Ecology. – M. : 2012. – 196p.
8. Koshelev V. M. Organic farming: economic aspect of transformation : monograph / V. M. Koshelev, A. V. Peshkova. – M. RSAU-MAA Publishing House, 2013. – 140 p.
9. Vasiltseva O. N. Classification of natural waters of hydrocarbonate chloride type (mathematic model and formation rules of its composition and properties) : monograph / O. N. Vasiltseva, N. I. Kornilov, E. N. Kornilova : Stavropol State Agrarian University. – Stavropol, AGRUS, 2009. – 180 p.
10. Podkolzin O. A. State and protection of agricultural ecosystems from pollution in the Central Fore-Caucasus : monograph / O.A. Podkolzin. – Stavropol, Self-employee V. L. Syrovets : Publishing and printing center “Paragraph”, 2009. – 352 p.
11. Semenchenko B. A. Physical meteorology : Textbook / B. A. Semenchenko. – M.: Aspect Press, 2002. – 415 p.
12. Environmental safety and energy of sustainable development –Prof. N. Kornilov
13. Green technologies for sustainable development - Prof. N. Tarasova
14. Energy efficiency improvement in natural and industrial systems - Prof. N. Popov
15. Lifecycle of energy, energy management and optimum decision-making - Prof. N. Shiryaeva
16. Energy and environmental audit
17. Basis of thermodynamics and exergy analysis- Prof. L. Tagliafico
18. Engineering and economic analysis of energy saving activities - Prof. V. Shutenko
19. Practical application of energy saving technologies - Prof. V. Semenov
20. Modelling technological and natural systems - Prof. Y. Panov
21. Bologna Issues and Glossary - Dr.Lilia Mozerova Mr.Angelo Musaio

Curriculum map for Master Study-Programme in Innovative Technologies for Energy Saving and Environmental Protection, «Green Master»

Module	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	C7	C8
Modern «Green» protection and energy saving technologies		X		X						X			X							
Introduction to thermodynamics of open systems: balance energy flows and substances in biosphere	X							X								X				
Practical using and methods of optimization of energy and resource saving technological systems				X						X			X			X				
Energy saving and ecological audit		X					X							X						
Modeling of Technological and Ecosystems					X				X			X						**X**		
Energy and environmental management											X					X				
Environmental Safety and Energy Sustainable Development			X						X					X		X				
English Language for Environmental Studies						X									X		X			
Monitoring of natural and technogenic systems									X		X		X						X	

Organic agriculture					X					X						X				
Environmental -monitoring laboratory						X			X		X		X				X		X	
Ecological reconstruction of rural areas					X					X									X	
Practice and research		X			X				X				X		X		X			X
Master’s thesis			X			X				X		X	X		X		X			X

Programme outcomes:

	Knowledge and understanding
A1	Ability to manage organizations, departments, groups of employees, projects and networks
A2	Ability to develop curricula and methodological support for management teaching
A3	Ability to use modern methods of corporate finance to the strategic objectives
A4	Ability to develop the program of organizational development and reforming and to ensure its implementation
A5	Ability to use quantitative and qualitative methods for research and business process management
A6	Knowledge of methods of economic and strategic analysis of the behavior of economic agents and markets in the global environment
A7	Ability to prepare analytical materials for business processes management and to assess their effectiveness
A8	Ability to summarize and critically evaluate the results obtained by domestic and foreign researchers, to identify and formulate relevant scientific problems

B4	Use appropriate information technology for professional and management purposes (e/g/risk analysis
B5	Modelling a variety of natural and industrial water systems
B6	Complex researches of branch, regional, national and global ecological issues in the sphere of energy saving and environmental protection, to develop the guidance for their solution
	Graduate skills
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))
C2	Identify and use various learning sources in students' scientific occupations
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)
C4	Make informed professional decisions based on scientific knowledge and appropriate criteria
C5	Work effectively individually or in groups to accomplish assigned tasks.

	Practical skills
B1	Be able to provide technical and managerial input into planning of water projects and facilities (in native language and in English)
B2	Conduct laboratory and field experiments, collect, analyse and interpret data
B3	Select and use appropriate methods and technologies for water use, reuse, recycling and purification

C6	Develop efficient time management skills
C7	Appreciate the social impact of research and practical work in the field of study
C8	Reflect and evaluate on own learning and evaluate peers in a professional manner

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