MASTER STUDY-PROGRAMME IN INNOVATIVE TECHNOLOGIES FOR ENERGY SAVING AND ENVIRONMENTAL CONTROL «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

and

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

Federal State Education Budget Institution of Higher Professional Education
Voronezh State University of Architecture and Civil Engineering
2014

University	Voronezh State University of Architecture and Civil Engineering, **Voronezh, Russia**
Programme level	**Master level**
Status	**Joint International Programme**
Name of the course	**Design, construction and maintenance of power effective and eco-friendly buildings**
Field and classification code	**Civil Engineering** 270800 (Russian education classification code)
Qualification	**Master of Engineering and Technology**
Web-site	**http://vgasu.vrn.ru**
Institute	Civil Engineering
Address	**84, 20-letiya Oktybrya Street, Voronezh, 394006**
Course length	**2 years**
Workload	**120 credits (in accordance with ECTS)** **4,320 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** - **Voronezh Design Institute "VoronezhProekt"**
Teaching organization	**Semester modules, front lectures, field visits, laboratory works, individual work, scientific supervising, Master thesis preparation**

Preliminary statement:

The students' workload in the Russian Federation is based upon academic hours. An academic hour means 45 minutes according to the regulations for Higher Education. These measures are settled in order to harmonize the Russian Federation academic system with the one of the Bologna Declaration. The following methodology guidelines are suggested from the Russian Ministry of Education and Science in order to boost the introduction of the ECTS to Russian universities.

The term "Zachetnaya edinitsa" ("Passing unit") was introduced and so-called "Russian credit unit" (RCU) is considered to be equal to 1 ECTS credit unit.

According to the methodology suggested by the Russian Ministry of Education and Science:

1 Russian credit unit (RCU) = 36 academic hours

1 academic week = 54 academic hours = 1.5 RCU

Discipline workload is calculated by dividing academic hours by 36

1 practical training week = 1.5 RCU

1 exam = 1 RCU

Final qualification work (project), (1 week = 1.5 RCU)

Aims of the programme:
The programme aims to:

1. provide Master students with the opportunity to deepen their knowledge of innovative technologies for energy saving in Civil Engineering and environmental protection;
2. provide students with the special knowledge and understanding of sustainable development concerning efficient use of energy resources;
3. provide students with the knowledge and skills needed to develop a career in the field of design, construction and maintenance of power effective and eco-friendly buildings, as well as alternative and renewable energy sources
4. develop student competence in a range of research methodologies;
5. develop student problem solving abilities in a range of situations;
6. provide the analytical skills needed at an advanced level to manage, critically evaluate and assess development in the area of energy saving and efficient use of natural resources to improve competitiveness due to cost reduction;
7. develop students' ability to critically review the links between global problems and policies and local management actions;
8. adopt a broad analytical approach to sustainable management in energy saving and environmental control which integrates theory and practice in a holistic manner

Programme languages: Russian and English

Admission criteria:

- **Bachelor or Specialist degree** in a relevant branch of Science or Engineering; work experience in the field is appreciated.
- **English language** (to be assessed by an interview) including the knowledge of Civil Engineering terminology.
- **Foreign** candidates are required to have the certificate of Russian language course attendance at B1 level or higher.

Teaching methods
Seminars, academic advising, practical work, creative workshops, problem solution classes, laboratory classes, internships, mobilities, industrial placement, e-learning.

The peculiar feature of the programme is introducing the **latest international education** achievements, 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 based upon those associated with the Bachelor's level and are at the forefront of the field studied;
- 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):

- problem solving based on critical thinking and including 'question typing' i.e. 'how should I do this question?' and decision making based on scientific approach;
- strategic, management and engineering skills in energy and resource saving technologies necessary for employment;
- understanding of the impact of innovative engineering solutions in terms of environment and society on all stages of design, construction and maintenance of energy efficient buildings;
- teamwork, in order to be able to communicate effectively and work in international and multidisciplinary teams;
- have an understanding of professional and ethical responsibility;
- time management;
- ability to learn on his/her own and realize the necessity of life-long learning.

Programme structure

Compulsory subjects (SES – a discipline required by the State educational standards of the Russian Ministry of Education and Science)

- Philosophical problems of science and technology **(**SES)
- The methodology of scientific research **(**SES)
- Special sections of mathematics **(**SES)
- Mathematical modelling **(**SES)
- Basics of pedagogy and androgogics **(**SES)
- Business foreign language **(**SES)
- Information technology in Civil Engineering **(**SES)
- Methods for solving scientific and technical problems in Civil Engineering
- Standards and legal base of energy saving
- Modern world experience of the solution of energy saving problems and increase of efficiency of energy utilization
- Life cycle of energy resources and real estate objects
- The main trends of energy saving at design, construction and maintenance of buildings
- Theory and practice of increase of energy efficiency

Elective subjects

- Environmental problems of energy saving and ways of their decision
- Economic justification of application of energy saving technologies
- Ecological safety and power sustainable development
- Environmental assessment and audit.

Practice and research experience (SES)
Master's thesis (SES)

Programme Outcomes

A. Knowledge and understanding	**Teaching/learning methods**
1. Fundamental knowledge and understanding of innovative technologies in energy saving and environmental control. 2. Understanding of optimization approach and methods of energy and resource saving processes. 3. Understanding of energy saving as the basis of green technologies development 4. Knowledge of administrative authorities and legislation in the field of environmental protection 5. In-depth knowledge of design, construction and maintenance of energy efficient buildings and energy saving technologies. 6. Knowledge of mathematical and analytical concepts and models for solving energy saving problems on all stages of design, construction and maintenance of energy efficient buildings; 7. Critical evaluation of current methods of energy production and utilization.	Students gain knowledge and understanding through lectures, seminars and laboratories attendance. Besides a variety of learning activities is conducted, such as: group projects, case study analysis, field trips, industrial placement and 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 methods** Students' knowledge and understanding are assessed by a variety of methods such as tests, laboratory reports, case study analysis, student presentations and examinations.
B. Practical skills 1 Ability to provide engineering and managerial input into planning of energy and resource saving projects and facilities (both in the Russian and English language). 2 Ability to solve engineering problems through the application of theoretical knowledge and practical skills in industrial environment. 3 Ability to carry out laboratory and field experiments, collect, analyse and interpret data. 4 Select and use appropriate methods and technologies for energy and resource saving. 5 Use appropriate Information Technology for engineering and management purposes (e.g. risk analysis) 6 Ability to design the energy effective buildings	**Teaching/learning methods** Students acquire cognitive skills through participating in seminars and laboratories, doing group and mini group projects, making case study analysis, having field trips, preparing 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 classify, assess, discuss, interpret and manipulate.

C. Graduate skills	Teaching/learning methods
1 Develop critical thinking and carry out research (e.g. compare their views and those that differ from their own both in Russian and English). 2 Identify and use various learning sources in learning activities 3 Communicate and negotiate effectively with different stakeholders individually and in-group using verbal, written, and electronic ways of communication (both in Russian and English). 4 Make 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 Evaluate social impact of research and practical work in the field of study 8 Personal and peers' reflection and evaluation of learning outcomes.	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, and specific modules attendance. 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.

Name of the discipline	Credit points (per semester)	Type of assess-ment in current semester	Academic staff
Semester 1			
Philosophical problems of science and technology	2	Written paper, test	Prof. Perevozchikova L.S.
Fundamentals of pedagogy and androgogy	2	test	Prof. Radugin A.A.
Business foreign language	3	test	Prof. Shitikova M.V. Docent Lukina L.V.
Mathematical modeling	2	test	Prof. Rossikhin Yu.A.
Standards and legal base of energy saving	2,5	examination	Docent Isanova A.V.
Modern world experience of the solution of energy saving problems	4	test	Docent Kononova M.S.
Bases of energy saving and increase of power efficiency	4	examination	Prof. Semenov V.N.
Power balance and energy audit	2	examination	Docent Isanova A.V.
Ecological expertise and audit	3	examination	Prof. Sazonov E.V.
	24,5		
Semester 2			
The methodology of scientific research	2	test	Prof. Shitikova M.V.
Special sections of the higher mathematics	2	Written paper, test	Prof. Sedaev A.A.
Standards and legal base of energy saving	1,5	test	Docent Isanova A.V.
Life cycle of energy resources and real estate objects	4	examination	Prof. Semenov V.N.
Methodology of cyclic dynamics of energy resources and real estate objects	2	test	Prof. Semenov V.N.
Practical recommendations concerning the application of energy saving technologies	*3*	examination	Docent Kitaev D.N.
Scientific and research work during semester	16,5	test	
Scientific and research practice	3	test	
Pedagogical practice	3	test	
	37		

Semester 3			
Information technologies in civil engineering	3	examination	Prof. Avdeev V.P.
Methods of the solution of scientific and engineering tasks in civil engineering dealing with energy saving and efficiency	2	test	Prof. Shitikova M.V.
The main trends of energy saving at design, construction and maintenance of buildings	2	Written paper, examination	Docent Semenova E.E.
"Green construction" for a sustainable development of territories	3	test	Prof. Sotnikova O.A.
Program-and- target methods increasing the effectiveness of energy	*3*	test	Docent Kitaev D.N.
Ecological safety and energy stable development	*3*	examination	Prof. Sazonov E.V.
Methodology of the assessment of energy saving procedures	2	test	Prof. Semenov V.N.
Assessment of technologies of increase of power efficiency	3	test	Prof. Semenov V.N.
	21		
Semester 4			
Scientific and research work	34,5	test	
Final state examination, Master thesis defense	3		
	37,5		
Total for 4 semesters	**120**		

Module 1

Module Title	**Theoretical bases of scientific research**
Course Titles	1. Philosophical problems of science and technology 2. Methodology of scientific research 3. Fundamentals of pedagogy and androgogy 4. Business foreign language
Credits	Total: 9 credits, 324 academic hours 1. 2 ECTS credits, 72 academic hours 2. 2 ECTS credits, 72 academic hours 3. 2 ECTS2 credits, 72 academic hours 4. 3 ECTS credits, 108 academic hours
Module leader and assistant (if any)	Prof. Shitikova M.V.
Study terms	1.Year 1, semester 1 2. Year 1, semester 2 3. Year 1, semester 1 4. Year 1, semester 1
Aim of the module The course introduces students to the current problems of scientific and technological development of modern society. Preparation of students to study new advanced concepts in Civil Engineering based on energy saving technologies. In-depth study of English as a language for adaptation for specific terminology in the field on energy saving on all stages of design, construction and maintenance of energy efficient buildings and structures, for reading special scientific and engineering literature, for utilizing international information data basis, for communication with colleagues in research and work teams. Study of the history and significance of Bologna Process for higher education development.	
Lectures	Semester 1: 36 hours Semester 2: 36 hours
Laboratory works, seminars	Semester 1: 108 hours Semester 2: 18 hours
Individual work	Semester 1: 108 hours Semester 2: 18 hours

Learning outcomes

Knowledge and understanding:

- forms and methods of scientific knowledge
- advanced trends in current scientific knowledge
- English as a language of business communication

Practical skills

- selection and implementation of methods of scientific research
- analysis of the problems of scientific and technological development of modern society
- development trends and perspectives of technological society
- oral and written English for business purposes

Graduate (or Transferable) skills

- ability for adaptation for advanced aspects and methods in Civil Engineering methods of scientific explanation and prediction based on energy saving technologies
- level of English required for work in an international interdisciplinary team

Assessment methods

Students' knowledge and understanding are assessed by a variety of methods such as tests, students presentations and examinations

Module 2

Module Title	**Mathematical analysis and modeling of power effective systems**
Course titles	1. Mathematical modelling 2. Special sections of the higher mathematics 3. Information technologies in civil engineering 4. Methods of the solution of scientific and engineering tasks in civil engineering dealing with energy saving and efficiency
Credits	Total: 9 ECTS credits, 324 academic hours 1. 2 ECTS credits, 72 academic hours 2. 2 ECTS credits, 72 academic hours 3. 3 ECTS credits, 108 academic hours 4. 2 ECTS credits, 72 academic hours
Module leader and assistant (if any)	Prof. Shitikova M.V.
Study terms	1. Year 1, semester 1 2. Year 1, semester 2 3. Year 2, semester 3 4. Year 2, semester 3

Aim of the module

The main aim of the module is to acquaint students with the advanced methodology of mathematical modelling needed for the reduction of the problem to be solved to the set of differential equations describing adequately the object under consideration. Students should get general knowledge and skills on mathematical formulation of the physical problem, derivation of governing equations in differential or integral form with further their analytical and/or numerical analysis. Students should also gain the skills for providing the comparison and estimation of divergence of the mathematical modelling results from experimental measurements.

In-depth knowledge of advanced information technologies applicable for solving the problems arising in Civil Engineering.

Lectures	Semester 1: 36 hours Semester 2: 36 hours Semester 3: 36 hours
Laboratory works, seminars	Semester 1: 18 hours Semester 2: 18 hours Semester 3: 108 hours
Individual work	Semester 1: 18 hours Semester 2: 18 hours Semester 3: 36 hours

Learning outcomes

Knowledge and understanding:

- advanced methods of mathematical analysis for solving the problems of energy saving
- detection and analysis of current problems of energy saving and their description with adequate mathematical models
- advanced information technologies

Practical skills

- selection and implementation of methods of research
- analysis and generalisation of the results of scientific research
- ability and willingness to apply the knowledge on modern methods of research in engineering practice
- application of new information technologies in research and engineering practice

Graduate (or Transferable) skills

- the choice of methods of theoretical and experimental verification of the adequacy of mathematical models adopted for solving different engineering problems
- skills to evaluate the adequacy and accuracy of the solutions obtained
- all-life learning of information technologies.

Assessment methods

Students' knowledge and understanding are assessed by a variety of methods such as the analysis of analytical and numerical research exercises, laboratory work, tests, students presentations and examinations

Module 3

Module Title	**Standards of energy saving ensuring and increase of power efficiency**
	1. Standards and legal base of energy saving 2. Modern world experience of the solution of energy saving problems 3. Bases of energy saving and increase of power efficiency
Credits	Total: 12 ECTS credits, 432 academic hours 1. 4 ECTS credits, 144 academic hours 2. 4 ECTS credits, 144 academic hours 3. 4 ECTS credits, 144 academic hours
Module leader and assistant (if any)	
Study terms	1. Year 1, semester 1, Year 1, semester 2 2. Year 1, semester 1 3. Year 1, semester 1
Aim of the module Gain the in-depth knowledge of standards and legal base of energy saving in Russia and EU countries, the comparison of their merits and demerits. Studying of modern world experience in solving the energy saving problems from different points of view. Advanced methods of increasing the power efficiency.	
Lectures	Semester 1: 72 hours Semester 2: 18 hours
Laboratory works	Semester 1: 144 hours Semester 2: 18 hours
Individual work	Semester 1: 162 hours Semester 2: 18 hours

Learning outcomes

Knowledge and understanding:

- standards and legal base of energy saving
- up-to-date world experience of the solution of energy saving problems
- methods resulting in the increase of power efficiency

Practical skills

- application of standards and legal base of energy saving in engineering practice
- application of up-to-date world experience of the solution of energy saving problems in research
- implementation of advanced methods resulting in the increase of power efficiency at all stages of design, construction and maintenance of buildings

Graduate (or Transferable) skills

- select the most efficient method for solving any particular problem
- skills to evaluate the efficiency of the solutions obtained

Assessment methods

Students' knowledge and understanding are assessed by a variety of methods such as tests, students presentations and examinations.

Module 4

Module Title	**Methodology of energy saving and increase of energy efficiency**
Course titles	1**.** Life cycle of energy resources and real estate objects 2. Methodology of cyclic dynamics of energy resources and real estate objects 3. The main trends of energy saving at design, construction and maintenance of buildings
Credits	Total: 8 ECTS credits, 288 academic hours 1. 4 ECTS credits, 144 academic hours 2. 2 ECTS credits, 72 academic hours 3. 2 ECTS credits, 72 academic hours
Module leader and assistant (if any)	Prof. Semenov V.N.
Study terms	1. Year 1, semester 2 2. Year 1, semester 2 3. Year 2, semester 3
Aim of the module The in-depth knowledge of life cycle of energy resources and real estate objects of various purpose and their interrelation. Methodology of evaluating and estimation of efficiency of cyclic dynamics of energy resources and real estate objects during their construction and maintenance. The formulation, evaluation and estimation of the main trends of energy saving at all stages of design, construction and maintenance of energy efficient buildings, and their utilization in engineering daily practice.	
Lectures	Semester 2: 54 hours Semester 3: 18 hours
Laboratory works	Semester 2: 108 hours Semester 3: 18 hours
Individual work	Semester 2: 54 hours Semester 3: 36 hours

Learning outcomes

Knowledge and understanding:

- Methods of the analysis and description of life cycle of energy resources and real estate objects
- Methodology of cyclic dynamics of energy resources and real estate objects
- Advanced energy saving technologies useful for design, construction and maintenance of energy efficient buildings

Practical skills

- To analyze the life-cycle of different energy resource
- To apply the methodology of cyclic dynamics of energy resources and real estate objects for the estimation of their current state
- To apply the advanced energy saving technologies for design, construction and maintenance of energy efficient buildings

Graduate (or Transferable) skills

- To create the energy efficient buildings
- Skills to deep into the new energy saving technologies using information from the literature.

Assessment methods

Students' knowledge and understanding are assessed by a variety of methods such as tests, course project, students presentations and examinations

Module 5

Module Title	**Theory and practice of increase of energy efficiency**
Course titles	1. Power balance and power audit 2. Program and target methods of increase of power efficiency (3. "Green construction" for a sustainable development of territories 4. Practical recommendations on the application of energy saving technologies
Credits	Total: 11 ECTS credits, 396 academic hours 1. 2 ECTS credits, 72 academic hours 2. 3 ECTS credits, 108 academic hours 3. 3 ECTS credits, 108 academic hours 4. 3 ECTS credits, 108 academic hours
Module leader and assistant (if any)	Prof. Semenov V.N.
Study terms	1. Year 1, semester 1 2. Year 2, semester 3 3. Year 2, semester 3 4. 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 every system 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 programs 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	Semester 1: 18 hours Semester 2: 18 hours Semester 3: 72 hours
Laboratory works, seminars	Semester 1: 36 hours Semester 2: 54 hours Semester 3: 72 hours
Individual work	Semester 1: 18 hours Semester 2: 36 hours Semester 3: 72 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 and audit tools
- Understand technologies of energy saving in branches
- Gain knowledge of "Green construction" for a sustainable development of territories

Practical skills

- Organize energy audit
- Recording/documenting audit results
- Statistical methods of data processing
- Develop recommendations
- Make audit reporting
- Implement practical recommendations on the application of energy saving technologies in daily engineering practice

Graduate (or Transferable) skills

- Define goals and objectives of energy and audit
- Choose assessment criteria for inspection results
- Prepare presentational materials
- Prepare forms to make the conclusion

Assessment methods

Students' knowledge and understanding are assessed by a variety of methods such as tests, students presentations and examinations

Module 6

Module Title	**Environmental problems of energy saving and ways of their decision**
Course titles	1. Environmental assessment and audit 2. Ecological safety and power sustainable development
Credits	Total: 6 ECTS credits, 216 academic hours 1. 3 ECTS credits, 108 academic hours 2. 3 ECTS credits, 108 academic hours
Module leader and assistant (if any)	
Study terms	1. Year 1, semester 1 2. Year 2, semester 3
Aim of the module The aim of this module is the necessity to introduce to the master students methods of environmental control. Traditional ecological audit, described in the present module, includes technical investigation, analysis of ecological safety and power sustainable development 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	Semester 1: 36 hours Semester 3: 36 hours
Laboratory works, seminars	Semester 1: 36 hours Semester 3: 36 hours
Individual work	Semester 1: 36 hours Semester 3: 36 hours

Learning outcomes

Knowledge and understanding:

- demonstrate the confidence and listening/speaking skills necessary to participate successfully in spontaneous oral exchanges with native speakers of foreign language in a variety of personal, professional, and/or academic settings;
- demonstrate reading comprehension of foreign language texts intended for developmental (or higher level) foreign language courses.
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Practical skills

- Organize ecological audit
- Recording/documenting audit results
- Statistical methods of data processing
- Develop recommendations
- Make audit reporting
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Graduate (or Transferable) skills

- Skills to estimate the ecological safety
- Ability to implement of power sustainable development issues in engineering practice

Assessment methods

Students' knowledge and understanding are assessed by a variety of methods such as tests, students presentations and examinations

Module 7

Module 7 **Title**	**Economic justification of application of energy saving technologies**
Course titles	1. Methodology of the assessment of efficiency of implementation of energy saving aspects 2. Assessment of technologies of increase of power efficiency
Credits	Total: 5 ECTS credits, 180 academic hours 1. 2 ECTS credits, 72 academic hours 2. 3 ECTS credits, 108 academic hours
Module leader and assistant (if any)	Prof. Semenov V.N.
Study terms	1. Year 2, semester 3 2. Year 2, semester 3
Aim of the module This module will provide the students with the knowledge of the methodology for the implementation of energy saving aspects at all stages of the design, construction and maintenance of energy efficient buildings. Economic aspects for the assessment of technologies resulting in the increase of power efficiency will be given.	
Lectures	Semester 3: 54 hours
Laboratory works, seminars	Semester 3: 72 hours
Individual work	Semester 3: 54 hours

Learning outcomes

Knowledge and understanding:

- Acquire knowledge of methods of productions economic efficiency calculation
- Gain the knowledge of the methodology for the assessment of efficiency of implementation of energy saving aspects at all stages of the design, construction and maintenance of energy efficient buildings

Practical skills

- skills for the assessment of advanced technologies resulting in the increase of power efficiency
- assess the quality of the obtained solutions with due account for economic criteria
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Graduate (or Transferable) skills

- skills to make the evaluation of the advanced technologies resulting in the increase of power efficiency and their further utilization in the engineering practice
- critical estimation of the quality of the obtained solutions based on the advanced economic criteria

Assessment methods

Students' knowledge and understanding are assessed by a variety of methods such as tests, students presentations and examinations

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Module 8

ModuleTitle	**Approved practical and research experience**
Credits	Total: 57 ECTS credits, 2052 academic hours 1. 6 ECTS credits, 216 academic hours for practice 2. 51 ECTS credits, 1836 academic hours for Master Thesis
Module leader and assistant (if any)	Prof. Semenov V.N. and all scientific supervisors
Study terms	1. Year 1, semester 2 2. Year 2, semester 2, Year 2, semester 4

Aim of the module

The module will be carried out in cooperation with a scientific supervisor in industrial organizations / research centres / university laboratories. Students will be inserted into research and practical activities with possible future employment perspective. Students will carry out projects and tasks assigned by the organizations. This experience will give them the opportunity to take initiatives as well as to develop the self-confidence, interpersonal and adaptation skills.

Research activities during the creation and fulfilment of their Master thesis will prepare students for future work in research and design institutions dealing with energy saving technologies at all stages of design, construction and maintenance of energy effective buildings and structures

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.

Research results to be included and implemented in master thesis

Module 9

Module Title	**Total state certification. Defence of Master thesis**
Credits	3 ECTS credits, 108 academic hours
Module leader and assistant (if any)	All scientific advisors
Study terms	Year II, semester IV.
Aim of the module To prepare Master Thesis according to all requirements	
Learning outcomes Preparation of the Master's thesis and passing 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
- Accreditation of the programme by the Academic Council of Vladimir State University
- Ministry of Education and Science of the Russian Federation official recognition (licensing)
- Evaluation by employers

Employment opportunities

Civil Engineering research and design institutions, Government and private construction enterprises, Municipal and Communal Service, Research and Quality Control Processes; Public Administration related to environmental protection; institutions and enterprises applying energy saving and 'Green construction' technologies. Graduates can work as industrial consultants for environmental protection.

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

1. Educational laboratory equipment set "The device, work and the account in systems of heating of the building" (LS/PO-URUSOZ)

The laboratory complex acquaints students with the main instrumentations used in systems of water supply and heating, the principles of their work and possibility of application, definition of performance data of elements of systems of heating.

The laboratory stand "The Device, Work and the Account in Systems of Heating of the Building" of floor execution represents the operating closed hydraulic system with the established samples of sensors which are applied in monitoring systems and the accounting of a consumption of water, pressure and water temperature control on objects of housing and communal services, and radiators of water heating. The system of pipelines and spherical cranes allows to model necessary for performance of laboratory works a configuration of system of heating.

The laboratory stand is intended for acquaintance of students with the main instrumentations used in systems of water supply and heating, studying of the principles of their work and possibility of application, definition of performance data of elements of systems of heating.

The personal computer is intended for management of operation of the stand as a whole, namely: operation of the pump, the electric boiler, spherical cranes with the electric drive.

In the package of delivery is included the electrified training module with training indication. The training module represents the interactive light-dynamic touch panel, allowing one to provide training and software testing to check of the acquired material. The marker touch surface allows one to bring adjustments in training process. The established software "The virtual teacher, allows to provide group training.

The module is the tool of the teacher allowing him/her to present a material on safety measures during the work with educational laboratory equipment in the sphere of housing and communal services.

Recommended literature

1. Kishimoto A. Advanced Energy Saving and its Applications in Industry, 2013. – 75 p.
2. Li Xianguo Green Energy. Basic Concepts and Fundamentals, 2011 - 288 p.
3. Magrini A. Building Refurbishment for Energy Performance, 2014. - 252 p.
4. Hakansson A. Sustainability in Energy and Buildings / Proceedings of the 4th International Conference in Sustainability in Energy and Buildings (SEB´12), 2013. – 554 p.
5. Howlett Robert J. Sustainability in Energy and Buildings/ Results of the Second International Conference in Sustainability in Energy and Buildings (SEB'10), 2011. – 302 p.
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Curriculum map for Master Study-Programme in Innovative Technologies for Energy Saving and Environmental Protection, «Green Master»

Module	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	C7	C8
Theoretical bases of scientific research	X	X	X	X					X	X	X				X	X	X		X		X	
Mathematical analysis and modeling of power effective systems	X	X	X	X		X	X		X	X	X			X	X		X	X	X		X	X
Standards of energy saving ensuring and increase of power efficiency					X	X	X	X	X	X	X	X		X	X	X		X	X		X	
Methodology of energy saving and increase of energy efficiency	X	X	X	X	X		X	X	X	X	X	X		X	X	X		X	X		X	
Theory and practice of increase of energy efficiency		X	X	X		X	X	X	X	X	X	X	X		X	X		X	X	X	X	
Environmental problems of energy saving and ways of their decision		X		X	X		X	X	X	X	X	X		X	X	X		X	X		X	X
Economic justification of application of energy saving technologies			X	X			X		X				X	X	X	X	X			X	X	
Scientific and research work in semester Research and pedagogical practice									X	X	X	X	X	X	X	X	X	X	X	X	X	X
Master Thesis									X	X	X	X	X	X	X	X	X	X	X	X	X	X

Programme outcomes:

	Knowledge and understanding
A1	Formulate physical and mathematical aspects of the research problem, choose and implement methods of conducting research, analyze and summarize the results of research, bring them to the practical implementation
A2	Gain in-depth knowledge of modern information technologies and methods for their use in professional activities
A3	Acquire knowledge of methods of numerical solution of model equations
A4	Understanding mathematical modelling opportunities for energy saving utilization in civil engineering
A5	Understand interrelations of energy and ecology
A6	Gain in-depth knowledge of audit technologies
A7	Gain knowledge of energy saving systems and equipment
A8	Gain in-depth knowledge of energy saving technologies at design, construction and maintenance of energy efficient buildings
	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	Solve engineering problems through the application of theoretical concepts and practical knowledge in industrial setting
B3	Conduct laboratory and field experiments, collect, analyse and interpret data
B4	Select and use appropriate methods and technologies for water use, reuse, recycling and purification
B5	Use appropriate information technology for professional and management purposes (e/g/risk analysis
B6	Modelling a variety of natural and industrial water systems
	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.
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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