MODULE SPECIFICATION

Module Title: **Energy efficiency in engineering systems**			University module code:	
Level[i]: **Bachelor**	Credit Value[ii]:	ECTS Value[iii]: **5** (in Russia 1 ECTS equals to 36 hours of work load)	Length (in Semesters)[iv] **1**	Semester(s) in which to be offered:
New module[v]:	Title of Module being replaced *(if any):* Energy saving in heating, ventilation and air-conditioning			With effect from[vi]:
Originating School: **KSTU, NTUU "KPI"**	Module Co-ordinator(s): **KSTU**			
Programme(s) in which to be offered:				
Pre-requisites *(between levels):*			Co-requisites *(within a level):*	
Indicative learning hours:	Percentage taught by School(s) other than originating School[vii] *:*			

In the discipline of "Energy efficiency in engineering systems" learn how to implement the legal, institutional, industrial, technical and economic measures aimed at the efficient use of energy resources and on into the commercial production of alternative and renewable energy sources.

Aims of Module:

- Introduction to the legislative and regulatory framework of the Russian Federation and the European Union in the field of energy saving;
- Acquisition of knowledge and skills on the thermodynamic and thermal and environmental basis of consumption and energy conversion systems engineering;
- Study of modern methods of analysis of the energy efficiency of systems engineering;
- Obtain information about the energy efficiency of the basic engineering systems (gas, heat, water, air conditioning, buildings) and how to improve it;
- Gain an in depth knowledge about the *sustainability indicators* at macro (city), meso (neighbourhood) and micro (building (accessibility, efficiency), citizen (happiness index, well being)) levels.
- Acquisition of theoretical knowledge and practical skills of calculation, design and operation of energy-efficient building systems and structures;
- Establish representations of the energy audit of buildings and structures, its goals, objectives, and legal implications of engineering;
- Provide information about modern perspectives, trends and problems in the development of energy saving.

Intended Learning Outcomes

Knowledge and Understanding

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On successful completion of this module, a student will be able to:

- Assess the energy efficiency of the engineering system based on the results energy audit or examination of design solutions;
- Apply the theoretical knowledge and practical skills in the design energy-efficient systems or implementing energy-saving measures in existing systems;
- Assess the technical and economic efficiency and environmental safety energy-saving measures;
- Explore and review knowledge about the *sustainability indicators* at macro (city), meso (neighbourhood) and micro (building (accessibility, efficiency), citizen (happiness index, well being)) levels.
- Make a building energy performance certificate and determine the most effective ways to reduce the cost of energy and material resources;
- Continue study of specific and general questions energy efficiency in order to carry out the functions of the energy and management consulting, and research in this area.

Transferable/Key Skills and other attributes

On completion of the module a student will have had the opportunity to:

- Participate in group discussions and presentations via the internet;
- Use Computer Learning Systems;
- Initiate professional, law-making and public events and energy efficiency projects.

Module mark calculation:[viii]

Assessment components (in chronological order of submission/examination date)

Type of assessment[ix]	Weighting%	Duration *(if exam)*	Word count *(if essay/dissertation):*	Component pass required[x]
Assessment of the degree of interaction and participation of the students (50% mark attributed to soft skills)	30%		n/a	Yes ☒ No ☐
Final assessment component Written Group Essay	70%	2 hours	5000	Yes ☒ No ☐

Learning and teaching strategies[xi]:

The total complexity of the program is 5 credits (SET), i.e., 180 academic hours are 70 hours of classroom lessons and 110 hours of independent work, including the implementation of a course project (explanatory note 30-35 A4 pages, the graphic part - one sheet A1). Classroom lessons are held in the form of lectures (30 hours) and practical (40 hours). At the lecture classes are considered the main domain concepts, methods of analysis and calculation of the energy efficiency of energy-saving equipment, the methodology of decision-making. Practical classes are held in the form of exercises for individual tasks aimed at the development of methods of calculation, as well as in the form of workshops to discuss controversial questions. Methodical maintenance of discipline of the course consists of lectures, guidelines for practical training and guidelines to implement the course of the project. For independent work and distance learning all the materials for this module are available through the Internet. Students can receive additional resources available on the Internet. Provides for interactive communication via the Internet for counseling, on-line discussions, current and total control. Summative assessment involves a written exam and a public Internet or through the protection of the course project.

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Moodle Virtual Learning Environment (VLE):
All students will be supported by extensive use of the Moodle virtual environment. The programmes utilise an e-based learning strategy to support delivery. The method adopts the following principles:
1. High quality integrated module content that combines a variety of types of information supporting the learning objectives of the module
2. Internet-based communication and submission of assessed work
3. On-line tutorial support during module delivery

Syllabus outline:

- Introduction to the module;
- The problem of energy conservation. Legislative and regulatory framework energy conservation;
- Thermodynamic, thermal energy and environmental basics of energy efficiency;
- Heat recovery devices;
- Overview of the energy and the technical and economic efficiency of engineering systems and design solutions;
- Energy efficiency of engineering systems (gas, water, heating, heating, ventilation, air conditioning);
- Developing and designing energy-efficient systems engineering, implementation energy-saving measures;
- Operation of energy-efficient systems engineering;
- Energy audits of buildings and structures;
- Prospects of energy saving.

Indicative texts and/or other learning materials/resources:

Core text:
- from the electronic library EBSCOhost
● 1. Schulz P., Nemecek J. Buildings and the Environment. In Energy Science, Engineering and Technology Series, New York: Nova Science Publishers, 2009.
● 2. Utrick J.B. Energy and Buildings: Efficiency, Air Quality and Conservation. New York: Nova Science Publishers, 2009.
- proposed by the authors of the module
● 3. Practical guide to the selection and development of energy-saving projects / under the general editorship. OL Danilova, PA Kostjuchenko. - JSC "Tehnopromstroy", 2006. - 668 p.
● 4. Fokin VM Fundamentals of energy conservation and energy audit / VM Fokin. - M.: "Publishing Engine-1", 2006. - 256 p.
● 5. Andrizhievsky AA Energy Saving and Energy Management: A Training Manual, 2nd ed. corrected. - Mn.: Your. wk., 2005. - 294.
● 6. Energy savings in power and heat technologies: a textbook for students enrolled in the direction of preparation "Thermal" / OL Daniel [and others], ed. AV Klimenko. - 2nd ed., Sr. - Moscow: MEI, 2011. - 424.
● 7. Samarin OD Thermal physics. Energy saving. Energy efficiency. - Moscow: Publishing House of the DIA, 2009.

Recommended text:
- from the electronic library EBSCOhost
● 8. Kijunen O., Hastesko T. Air Conditioning Systems: Performance, Environment and Energy Factors. In Energy Science, Engineering and Technology Series, New York: Nova Science Publishers, 2010.
● 9. Thumann A. Energy Conservation in Existing Buildings Deskbook. Lilburn, GA: Fairmont Press, 1992.
● 10. Thumann A., Younger W.J. Handbook of Energy Audits. Lilburn, GA: Fairmont Press, 2008.
● 11. Sugarman S.C. HVAC Fundamentals. Lilburn, GA: Fairmont Press, 2007.
● 12. Thumann A. Plant Engineers and Managers Guide to Energy Conservation. Lilburn, GA: Fairmont Press, 2010.
● 13. Wu C. Thermodynamics and Heat Powered Cycles: A Cognitive Engineering Approach. New

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York: Nova Science Publishers, 2007.
● 14. Zhang L.-Z. Total Heat Recovery: Heat and Moisture Recovery From Ventilation Air. New York: Nova Science Publishers, 2008.
- proposed by the authors of the module
● 15. Batishchev VE Energy Saving / VE Batishchev etc. - Yekaterinburg, 1999. - 304.
● 16. Boguslavskiy LD Energy savings in heating, ventilation and Air conditioning: A Reference Guide / LD Bohuslav, etc. - M. Stroyizdat, 1990. - 336.
● 17. The technology of energy saving in buildings: The European Experience / / AVOK. - 2013. - № 1. - S. 36-45
● 18. Sergey Pugachev, Tabunschikov YA, Naumov A., E. Fadeev The Russian concept of rationing energy efficiency of buildings and structures / / AVOK. - 2011. - № 8. - S. 4-11.
● 19. Brodach M.M. Review of the legal framework of the European countries in the field of energy conservation / / AVOK. - 2011. - №. 8. - S. 16-25.
● 20. Granovsky VL Energy-efficient heating system: trends, practices, challenges / / AVOK. - 20011. - № 8. - S. 40-47.
● 21. Global trends in energy efficiency of buildings / / Power Saver. - 2012. - № 5. - S. 38-42
● 22. Dick van Dijk Overall energy performance of buildings // Rehva Journal. - 2011. – January. – P. 10-15.
● 23. Becchio C., Corgnati S.P., Ballarini I., Corrado V. Energy saving potential by retrofitting residential buildings in Europe // Rehva Journal. – 2012. – December. – P.34-38.
● 24. Magyar Z. Buildings in the key role in the EU Energy Efficiency Action Plan // Rehva Journal. – 2011. – May. – P.86-88.
● 25. Larsen T.S. Overheating and insufficient heating problems in low energy houses up to now call for improvements in future // Rehva Journal. – 2011. – May. – P. 36-40.
Journals:
● AVOK;
● Energy efficiency;
● ASHRAE Journal;
● REHVA Journal.

***On-line resources*:**

EU Smart Cities Stakeholder Platform: www.eu-smartcities.eu
ESF Smart Cities Initiative: www.esf.org/smartcities
EuroCities: www.eurocities.eu
EU Covenant of Majors: www.eumayors.eu

Date of completion of this version of Module Specification …….....

Date of approval by the Faculty Programme Approval and Review Sub-committee: ……

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[i] *indicate level (e.g. first, second or third cycle; sub-level if applicable). All qualifications in the European Higher Education Area are located within three cycles - undergraduate; graduate and doctoral studies*
[ii] *permissible credit values as set out in Institution's Academic Regulations*
[iii] *European Credit Transfer System*
[iv] *indicate 0.5, 1, 1.5 or 2*
[v] *delete as applicable*
[vi] *insert month and year of first/next delivery of module*
[vii] *identify all participating Schools other than Originating School*
[viii] *To be defined*
[ix] *please indicate, in chronological order of submission date, each assessment component by type, e.g. examination, oral, coursework, project, dissertation*
[x] *indicate* Yes *to specify the assessment component(s) to be passed in order to pass the module*
[xi] *please note the requirement to give full consideration to issues of equality, diversity and accessibility*

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