Integrating education with consumer behaviour relevant to energy efficiency and climate change at the universities of Russia, Sri Lanka and Bangladesh (BECK)

MODULE SPECIFICATION

Originating Institution, Department	Module Co-ordinator(s)
Peter the Great Saint-Petersburg Polytechnic University, Higher School of Hydraulic and Power Engineering	Prof. Viktor Elistratov Assoc. Prof. Irina Kudryasheva Assoc. Prof. Mikhail Romanov Assistant Inna Bogun Assistant Roman Denisov

TITLE OF THE MODULE

Title of the module	Module code[1]
Renewable Energy: Resources and Technologies	

PROGRAMME(S) IN WHICH TO BE OFFERED:

Energy Efficient and Sustainable Building

LEVEL OF STUDIES[2]

First cycle (BSc/BA) ☐	Second cycle (MSc/MA) ☒	Third cycle (PhD) ☐

CREDITS AND LEARNING HOURS

Credit Value[3]	ECTS Value[4]	Indicative academic learning hours[5]	Length (in Semesters)[6]	Year in which to be offered
4	4	140	1	1

[1] To be indicated by the Institution
[2] According to the Framework of Qualifications for the European Higher Education Area, Annex 8: http://www.aic.lv/ace/ace_disk/Bologna/Bergen_conf/Reports/EQFreport.pdf
[3] Permissible credit values as set out in Institution's Academic Regulations
[4] European Credit Transfer System, 1 ECTS = 25-30 academic learning hours. Please refer to ECTS Users' Guide: https://ec.europa.eu/education/ects/users-guide/docs/ects-users-guide_en.pdf
[5] 1 academic learning hour is equal to 45 minutes
[6] Indicate 0.5, 1, 1.5 or 2

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ANNOTATION OF THE MODULE[7]

During mastering the course, students will familiarize with the basic concepts and definitions in the field of renewable energetics. Students will get an idea about the basics of determining the potential of renewable energy resource, including its territorial, temporal and climatic variability. Much attention is paid to the study of modern principles and technologies for converting solar, wind and hydro energy, as well as to operating modes of power plants based on renewables in power supply systems for autonomous and grid consumers. Within the framework of the concept of sustainable development, an analysis and quantitative comparison of the environmental impacts of organic, nuclear and renewable energy is carried out. The use of design, financial and economic management tools, taking into account the development of innovative technologies for creating renewable energy equipment, allows to optimize the parameters and increase the efficiency of projects.
The course contains a large number of practical tasks to consolidate the acquired knowledge and skills in the field of using renewable energy sources.

AIM OF THE MODULE[8]

The aim of the course is to form a system of knowledge among students about the current state and promising technologies of the most dynamically developing energetics field–conversion of renewable energy sources and formation of practical skills in choosing power plants based on them, determining power plants parameters and operating modes for energy supply to individual and large consumers in electric power systems.

MOOC LEARNING AND TEACHING STRATEGIES

The MOOC course has to contribute to an opening up of education to the benefit of both learners and the society at large while reflecting values such as equity, quality and diversity. The common features of the course are:

- Openness to learners: open entry (no formal pre-requisites), freedom to study at the time, place and pace of your choice, flexible pathways, fit for a wide variety of lifelong learners;
- Digital openness: courses available online;
- Learner-centred approach: courses aid students to construct their own learning from a rich environment, and to share and communicate it with others;
- Independent learning: a MOOC provides high quality materials to enable the progress of an independent learner through self-study;
- Media-supported interaction: course materials make best use of online affordances (interactivity, communication, collaboration) as well as rich media (video and audio) to engage students with their learning etc.

This MOOC course is practically oriented and contains a large number of test and practical tasks.
Methods of learning and teaching of the course:
- Video lectures: every single lecture is represented in one or more video fragment. Total duration of each fragment of a lecture is up to ten minutes that makes it well understandable and easy-to-use for educational purposes. All the videos are supported with illustrative materials.

[7] Please provide brief summary of the module, up to 200 words
[8] Aim of the module must correspond to the BECK Capacity Building Framework

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- Long reads: every lecture is represented in text version with wider explanation of a material and includes lots of illustrations. Within the set of videos listeners will find logical connection, which is represented in wider form in textual version. - E-practical task: description of a practical task is represented in textual format with step-by-step explanation on the MOOC platform. It is orientated on hard skills formation. - Testing of knowledge: each part of the module includes tests on knowledge evaluation as well as final test at the end of the course. Feedback: 1) use of a forum for operational communication and consultation; 2) communication with a student using E-mail.

INTENDED LEARNING OUTCOMES AND ASSESSMENT

Learning Outcomes of the module[9]	***Methods of studies***	***Assessment methods of student achievements[10]***	***Assessment criteria of student achievements by assessment levels***
O1. Able to know state-of-the-art and future possibilities renewable energy in the world	Fully online training	☐ Problematic questions ☐ Intelligent tests ☒ Regular tests ☒ Problematic tasks ☐ Projects ☒ Peer evaluation ☒ Automated feedback ☐ Final evaluation ☐ Other: practical task	*Threshold achievement level* Able to understand development dynamics and potential of renewable energy sources in the world *Typical achievement level* Able to know basic principles of energy science development in general *Excellent achievement level* Able to find necessary information in the proposed literature
O2. Able to estimate the potential of water, wind and solar resources.	Fully online training	☐ Problematic questions ☐ Intelligent tests ☒ Regular tests ☒ Problematic tasks ☐ Projects ☒ Peer evaluation ☒ Automated feedback ☐ Final evaluation ☐ Other: practical task	*Threshold achievement level* Able to understand and quantitatively assess of renewable energy sources potential. *Typical achievement level* Able to understand the main technical schemes of renewable energy sources use.

[9] Learning outcomes are specified in three categories – as **knowledge, skills and competence**. This signals that qualifications – in different combinations – capture a broad scope of learning outcomes, including theoretical knowledge, practical and technical skills, and social competences where the ability to work with others will be crucial. Please refer to Cedefop (2017). Defining, writing and applying learning outcomes: a European handbook. Luxembourg: Publications Office of the European Union. https://www.cedefop.europa.eu/files/4156_en.pdf. Learning outcomes of the module must correspond to the BECK Capacity Building Framework.

[10] Please select from the list. Additional assessment methods may be added.

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			Excellent achievement level Able to qualitatively and quantitatively chose the best project variant realization on the base of renewable energy sources.
O3. Able to know renewable energy conversion technologies	Fully online training	☐ Problematic questions ☐ Intelligent tests ☒ Regular tests ☒ Problematic tasks ☐ Projects ☐ Peer evaluation ☒ Automated feedback ☐ Final evaluation ☐ Other: practical task	*Threshold achievement level* Able to understand and chose the modern equipment for hydro, wind and solar plants
			Typical achievement level Able to substantiate the main parameters of hydro, wind and solar plants
			Excellent achievement level Able to qualitatively and quantitatively to assess the variant of project on the base of renewable energy sources
O4. Able to estimate the efficiency of hybrid energy systems	Fully online training	☐ Problematic questions ☐ Intelligent tests ☒ Regular tests ☒ Problematic tasks ☐ Projects ☒ Peer evaluation ☒ Automated feedback ☐ Final evaluation ☐ Other: practical task	*Threshold achievement level* Able to calculate the efficiency of hybrid energy projects
			Typical achievement level Able to qualitatively and quantitatively assess the technical parameters of hybrid energy system
			Excellent achievement level Able to understand and qualitatively assess the effectiveness of design solutions for isolated regions
O5. Able to estimate the efficiency of design solutions reducing negative effect on the environment and evaluate the project parameters with risk situations	Fully online training	☐ Problematic questions ☐ Intelligent tests ☒ Regular tests ☒ Problematic tasks ☐ Projects ☐ Peer evaluation ☒ Automated feedback ☐ Final evaluation ☐ Other:	*Threshold achievement level* Able to understand and qualitatively assess the effectiveness of design solutions that reduce the negative impact of RES on the environment
			Typical achievement level Able to qualitatively and quantitatively assess the effectiveness of design solutions that reduce the negative impact of RES on

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			the environment with minor errors
			Excellent achievement level Able to qualitatively and quantitatively assess the effectiveness of design solutions that reduce the negative impact of RES on the environment

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MODULE MARK CALCULATION[11]:

Assessment components (in chronological order of submission/examination date)				
Type of assessment[12]	Weighting, %	Duration *(if exam)*	Word count *(if essay or similar):*	Component pass required[13]
Assessment of the degree of interaction and participation of the students	0 %			Yes ☐ No ☒
Practical assignments during the course	50 %			Yes ☒ No ☐
Written Group Essay	0 %			Yes ☐ No ☒
Online examination (tests)	50%			Yes ☒ No ☐
Total:	100%			

SYLLABUS OUTLINE

No.	**Topic[14]**	**Number of hours[15]**
	Chapter 1. The world current state and development trends of renewable energy sources	24,0
1.	Current state and development trends of fuel and energy sector	
2.	Analysis of the global consumption of traditional and renewable energy sources	
3.	Sources of renewable energy. Climatic changes and their impact on renewable energy resource	
	Chapter 2. Assessment of renewable energy sources	24,0
4.	Assessment and use of water resources. Hydro potential categories. Technical schemes for the watercourse energy use	
5.	Wind flow and its formation. Wind flow characteristics and determination of a wind turbine main parameters	
6.	Solar radiation and its characteristics for energy use	
	Chapter 3. Renewable energy conversion technologies	34,0
7.	Types of hydropower units. The main parameters of hydropower plants and their definition. Energy conversion and hydroelectric equipment	

[11] Please list all components, sum must be equal to 100%. Note that successful course completion should be recognised as indicating worthwhile educational achievement.
[12] Please indicate in chronological order of submission date each assessment component by type, e.g. examination, home work, coursework, project
[13] Indicate Yes to specify the assessment component(s) to be passed in order to pass the module
[14] Please add as many topics as needed
[15] Includes self-learning, on-line conferences and consultations

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8.	Types and features of wind turbines. Wind power plant. Wind power plants in the power grid	
9.	Converting solar energy to electricity and heat	
10.	Operation modes of renewable energy facilities in the power grid	
11.	Design principles for power plants based on renewable energy sources	
	Chapter 4. Autonomous power supply using RES-based hybrid systems	26,0
12.	Prerequisites for integrated use of renewable energy sources and creation of hybrid systems.	
13.	Operation principles of hybrid systems based on renewable energy sources	
14.	Operating modes of hybrid systems based on renewable energy sources in autonomous generation	
15.	Energy and economic substantiation of hybrid systems based on traditional and renewable energy sources	
	Chapter 5. Economics and ecology of renewable energy sources	32,0
16.	Indicators and performance criteria for energy projects in the capacity and electric power markets	
17.	Efficiency of renewable energy projects, taking into account risks and spatial and temporal variability of resources	
18.	Sustainable development and renewable energy sources	
19.	The main factors of the impact of renewable energy sources on the environment and their assessment	
	Total:	**140**

LEARNING MATERIALS[16]

Core materials (up to 5 references):

1. N.L. Panwar et al. Role of renewable energy sources in environmental protection: A review / Renewable and Sustainable Energy Reviews 15 (2011) 1513–1524
2. Everett, B., Boyle, G. A., Peake S. and Ramage, J. (eds) (2012) Energy Systems and Sustainability: Power for a Sustainable Future (2nd edn), Oxford, Oxford University, Press/Milton Keynes, The Open University.
3. Daniel C P Prowse 2011 Wind Energy International Combining wind and hydropower 365 p.
4. Renewable Energy: Power for a Sustainable Future. Fourth Edition by Stephen Peake. Oxford University Press, 2018, 656 p. ISBN 9780 198759751.
5. Sharma Atul, Shukla, Amritanshu and Aye, Lu. Low Carbon Energy Supply - Trends, Technology, Management. 2018. doi: 10.1007/978-981-10-7326-7.
6. Sikdar Subhas K., Princiotta Frank. Advances in Carbon Management Technologies : Carbon Removal, Renewable and Nuclear Energy, V. 1. CRC Press. 2020. 476 p.

Supplementary materials (up to 10 references):

1. H.L. Raadal et al. Life cycle greenhouse gas (GHG) emissions from the generation of wind and hydro power / Renewable and Sustainable Energy Reviews 15 (2011) 3417– 3422.

[16] Courses should provide high quality materials to enable an independent learner to progress through self-study. Materials should make best use of online affordances (interactivity, communication, collaboration) as well as rich media (video and audio) to engage students with their learning.

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2. V.Katinas et al. Analysis of the wind turbine noise emissions and impact on the environment / Renewable and Sustainable Energy Reviews 58 (2016) 825–831.
3. Elistratov, V.V.; Denisov, R.S. Energetic and ecological justification of RE-hybrid systems for vulnerable ecosystems. IOP Conf. Series: Earth and Environmental Science 2021, 689. doi:10.1088/1755-1315/689/1/012017.
4. Elistratov, V.V.; Panfilov, A.A.; Konyschev, M.A.; Denisov, R.S. The Application of Adapted Materials and Technologies to Create Energy Systems Based on Renewable Energy Sources under Harsh Climatic Conditions. Applied Solar Energy 2018, 54(6), 472-476.
5. Elistratov, V.; Konischev, M. and Fedorov, M. Optimization of power supply of the circumpolar territories on the basis of renewable energy sources. Intern. Conf. on Industrial Engineering, Applications and Manufacturing, ICIEAM 2017, 2017, doi 10.1109/ICIEAM.2017.8076220
6. Elistratov, V.; Kudryasheva, I.; Pilipets, P. Energy efficient solutions of power supply in north regions. Applied Mechanics and Materials 2015, 725-726, 559-568.
7. Windpower Engineering & Development https://www.windpowerengineering.com/

On-line resources[17]:

1. Climate ADAPT: https://climate-adapt.eea.europa.eu
2. International Energy Agency https://www.iea.org/
3. IRENA - International Renewable Energy Agency: https://irena.org/
4. BP p.l.c. https://www.bp.com/
5. REN21. Renewables Now https://www.ren21.net/
6. World Energy Council https://www.worldenergy.org/
7. Global Wind Energy Council https://gwec.net/
8. BloombergNEF (BNEF) https://www.bloomberg.com/
9. Global Energy Statistical Yearbook https://yearbook.enerdata.net/

Other materials:
Lecture materials are available on the Coursera educational platform.

REQUIRED IT RESOURCES[18]

No.	Software, manufacturer
1.	Google Chrome
2.	MS Excel
3.	MS Power Point
4.	MS Word
5.	Adobe Acrobat reader

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

Date of approval by the Faculty: ……

[17] Please provide links
[18] Please add as many software as needed for the course

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