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)
Tallinn University of Technology, Department of Civil Engineering and Architecture	Prof. Irene Lill Assoc. Prof. Emlyn Witt

TITLE OF THE MODULE

Title of the module	Module code[1]
Simulation of Construction Management Strategies for Energy Efficiency	EPX5550

PROGRAMME(S) IN WHICH TO BE OFFERED:

Construction Management Structural Engineering Architecture

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
6	6	160	1	5 (Masters) / 1 (Doctoral studies)

---

[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

ANNOTATION OF THE MODULE[7]

The module involves a multiple criteria simulation game in which the (BIM) information model of a building is used as the basis for simulating different solutions. Energy efficiency indicators and outcomes determine the value of solutions over the whole building life. The students work in stakeholder-based groups to develop, argue and present solution proposals and work out compromise solutions with a focus on energy efficiency.

The module promotes the development of a green built environment by enabling students:
- To experiment with different solutions and evaluate the effectiveness of alternative options.
- To get insights into the roles and interests of all the construction industry stakeholders including users in construction projects and into how their decisions, actions and behaviours influence the energy efficiency of buildings.
- To develop teamwork skills and abilities for critical discussion and argumentation to optimise solutions and find compromises.

AIM OF THE MODULE[8]

To enable students to understand the roles of different stakeholders, their interests and how each stakeholder influences the overall value of the built environment with regard to energy efficiency and climate change.

MOOC LEARNING AND TEACHING STRATEGIES

This MOOC contributes to opening access to education for the benefit of both of learners and wider society while reflecting values such as equity, quality and diversity. The course learning strategy features:
- Openness - open entry (no formal pre-requisites), freedom to study at any time and in any place, the course is accessible to the widest diversity of students possible. Course activities, tasks and routes are designed in such way that they can be performed at different levels of difficulty or complexity, to account for a broad spectrum of students' knowledge and skills.
- A learner-centred approach - the course helps students to construct their own learning from a rich environment, and to share and communicate it with others.
- Independent learning - the MOOC enables an independent learner to progress through self-study. The course provides learners with regular feedback through self-assessment activities, tests or peer feedback. The MOOC includes possibilities for students to follow their scores and progression.
- 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 and sufficient interactivity (learner to content, learner to learner and learner to teacher) to encourage active engagement. Feedback of academic tutors is limited and scalable.
- Recognition - successful course completion will be recognised as indicating worthwhile educational achievement and certificated.

---

[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

The innovative Simulated Big Data Interuniversity Networked Affective Educational Centre (BECK Centre) will enable the delivery of the MOOC within the Moodle learning environment.

The pedagogical model of the course is such that the efforts of all services do not increase significantly as the number of participants increases. All aspects of the course are delivered online. Learning outcomes are assessed using a balance of formative and summative assessment appropriate to the level of certification.

The course teaching strategy is to provide all learning materials in a clearly-structured and easy-to-understand way online. These materials will be available on Moodle and will include:

- Relevant background information.
- Overall objectives and work-flows for the simulation game.
- Stakeholder descriptions detailing their scope of work, work-flows, commercial interests, responsibilities.

 In order to apply what they have learned, students are required to develop solutions in groups. These may be virtual (online) groups, colocated groups or mixed groups (incorporating both online and colocated students). However, group members must work concurrently and within a specified time.   The solutions developed by student groups will form inputs to other student groups and the effectiveness and quality of each developed solution will be primarily peer assessed by the group receiving the work as an input to their own work.

INTENDED LEARNING OUTCOMES AND ASSESSMENT

Learning Outcomes of the module[9]	Methods of studies	Assessment methods of student achievements[10]	Assessments criteria of students achievements by assessment levels
O1. Will understand the different interests of stakeholders in achieving energy efficient buildings.	Blended learning, integrated affective tutoring and affective computing methods. The Integrated Method include the computer learning	☒ Problematic questions ☐ Intelligent tests ☐ Regular tests ☒ Problematic tasks ☒ Projects ☒ Peer evaluation ☐ Automated feedback ☐ Final evaluation	*Threshold achievement level* Knows the concepts, theories and perspectives of different stakeholders with regard to the green built environment, energy efficiency and climate change, but is not able to

---

	systems, big data mining, affective tutoring system, access to e-sources (open-source videos, simulators (calculators and software), case studies from the best universities around the world), self-study in Moodle virtual environment (educational material including Video – audio material, Text material; Interaction in forums for building learning community; Exercises with integrated feedback mechanism); Live events (video conferencing)	☐ Other	explain and apply in wider context
			Typical achievement level Able to explain and apply the concepts, theories and perspectives of different stakeholders with regard to the green built environment, energy efficiency and climate change.
			Excellent achievement level Able to explain and apply the concepts, theories and perspectives of different stakeholders with regard to the green built environment, energy efficiency and climate change in wider context
O2. Be able to argue their points of view and justify the decisions made.	Blended learning, integrated affective tutoring and affective computing methods.	☒ Problematic questions ☐ Intelligent tests ☐ Regular tests ☒ Problematic tasks ☒ Projects ☒ Peer evaluation ☐ Automated feedback ☐ Final evaluation ☐ Other:	*Threshold achievement level* Able to research and make decisions in the development of context-relevant solutions for the green built environment in relation to energy efficiency and climate change by using modern ICT technologies at a basic level
			Typical achievement level Able to research and make decisions in the development of context-relevant solutions for the green built environment in relation to energy efficiency and climate change by using modern ICT
			Excellent achievement level Able to research and make decisions in the development of context-relevant solutions for the green built

			environment in relation to energy efficiency and climate change by using modern ICT at an advanced level
O3. Have gained near real-life experience in decision-making, communication and teamworking.	Interactive group work in developing context-relevant solutions.	☐ Problematic questions ☐ Intelligent tests ☐ Regular tests ☒ Problematic tasks ☐ Projects ☒ Peer evaluation ☐ Automated feedback ☒ Final evaluation ☐ Other:	*Threshold achievement level* Has basic skills to develop, communicate, manage and negotiate context-relevant solutions for the green built environment in relation to energy efficiency and climate change.
			Typical achievement level Has intermediate skills to develop, communicate, manage and negotiate context-relevant solutions for the green built environment in relation to energy efficiency and climate change.
			Excellent achievement level Has advanced skills to develop, communicate, manage and negotiate context-relevant solutions for the green built environment in relation to energy efficiency and climate change.

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 participation of the students, their input to group activities and satisfactory group outputs	20%			Yes ☒ No ☐

---

[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

Individual reflection on learning	10%		500 words	Yes ☒ No ☐
Group peer evaluations	40%			Yes ☒ No ☐
Group presentations	30%	30 minutes		Yes ☒ No ☐
Total:	100%			

SYLLABUS OUTLINE

No.	Topic[14]	Number of hours[15]
1.	Introduction to the module	5
2.	Building user behaviour modelling for energy efficiency	10
3.	Client's objectives and information requirements	10
4.	Designers' objectives and information requirements	10
5.	Construction objectives and information requirements	10
6.	Facilities management objectives and information requirements	10
7.	Other stakeholders' objectives and information requirements	10
8.	Setting energy efficiency optimization criteria and functions	10
9.	Project simulation	50
10.	Energy optimization	20
11.	Feedback and reporting	15
	Total:	**160**

LEARNING MATERIALS[16]

Core materials (up to 5 references):

1. Sulakatko, V.; Lill, I. (2019). The Economic Relevance of On-Site Construction Activities with the External Thermal Insulation Composite System (ETICS). International Journal of Strategic Property Management, 23 (4), 213–226. https://doi.org/10.3846/ijspm.2019.7071
2. Lill, I. (2018). Energetically and ecologically sustainable, affordable and healthy built environment. International Journal of Strategic Property Management, 22 (4), 234–235. https://doi.org/10.3846/ijspm.2018.3687
3. Kuusk, K.; Kalamees, T.; Link, S.; Ilomets, S.; Mikola, A. (2017). Case-study analysis of concrete large-panel apartment building at pre- and post low-budget energy-renovation. Journal of Civil Engineering and Management, 23 (1), 67–75. https://doi.org/10.3846/13923730.2014.975741

---

[14] Please add as many topics as needed
[15] Includes self-learning, on-line conferences and consultations
[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.

4. Castronovo, F., Van Meter, P. N., Zappe, S. E., Leicht, R. M., & Messner, J. (2017). Developing problem-solving skills in construction education with the virtual construction simulator. International Journal of Engineering Education, 33(2), 831-846.
5. Liias, R.; Ojamäe, L. (2017). Privatised Blocks in Estonia: Space for Sustainable Reconstruction? In: S. Gromark, M. Ilmonen, K. Paadam, E. Støa (_EditorsAbbr). Ways of Residing in Transformation. Interdisciplinary Perspectives (221–241). Routledge.

Supplementary materials (up to 10 references):

1. Castronovo, F. (2019) Design and Development of a Virtual Reality Educational Game for Architectural and Construction Reviews.
2. Andrić, I., Koc., M., & Al-Ghamdi, S. G. (2019). A review of climate change implications for built environment: Impacts, mitigation measures and associated challenges in developed and developing countries. Journal of Cleaner Production, 211, 83-102. https://doi.org/10.1016/j.jclepro.2018.11.128
3. Pikas, E.; Kurnitski, J.; Liias, R.; Thalfeldt, M. (2015). Quantification of economic benefits of renovation of apartment buildings as a basis for cost optimal 2030 energy efficiency strategies. Energy and Buildings, 86, 151–160. https://doi.org/10.1016/j.enbuild.2014.10.004
4. Taylor, J. E., & Bernstein, P. G. (2009). Paradigm trajectories of building information modeling practice in project networks. *Journal of management in engineering*, *25*(2), 69-76.
5. Chatterton, T., & Department of Energy and Climate Change. (2011). An introduction to thinking about 'energy behaviour': A multi-model approach. Department of Energy and Climate Change, London. Available at: https://uwe-repository.worktribe.com/output/957138

On-line resources[17]:
1. Climate Action Tracker: https://climateactiontracker.org/
2. Green Growth Knowledge Platform: https://www.greengrowthknowledge.org/theme/climate-change
3. Climate Change & Resilience Information Centre: https://careclimatechange.org/
4. Climate ADAPT: https://climate-adapt.eea.europa.eu

Other materials:
Lecture materials available at the BECK Simulated Big Data Interuniversity Networked Affective Educational Centre.

REQUIRED IT RESOURCES[18]

No.	Software, manufacturer
1.	Autodesk Revit
2.	Autodesk Navisworks Manage
3.	MS Excel
4.	Adobe Acrobat reader

---

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

Date of completion of this version of Module Specification: 6th November 2019

Date of approval by the Faculty: 13th November 2019 (approved by Study Programme
Director)