Name of the module (English): Resilient and Sustainable Built Environment					
Module code (UP): M32 (provisional)		**Name of the module (Portuguese):** Ambiente Construído Resiliente e Sustentável			
Module code (THM): IMTM (provisional)		**Name of the module (German):** Widerstandsfähige und nachhaltig gebaute Umwelt			
Module code (UC): M32 (provisional)		**Name of the module (Spanish):** Ambiente construido resiliente y sostenible			
Credits: 6 ECTS	**Module status:** Obligatory	**Duration:** 1 semester	**Semester:** 2	**Year:** 1	**Frequency:** Every year
Type of tuition: Classroom-based		**Workload:** 180 h	**Attendance time:** 60 h	**Self-study time:** 120 h	
Usability: Master (Degree in Sustainable Design, Construction and Management of the Built Environment)			**Classification:** Engineering / Architecture	**Teaching language:** English	
Module responsibility: Jorge Rodríguez Hernández (UC)		**Lecturers:** Maria Helena Póvoas Corvacho (FEUP)			

Description / Observations:

Built environment (buildings and infrastructures of any kind that compounds cities and human facilities) is facing the challenge of the adaptation to Climate Change worldwide. Extreme temperatures and rains are the main risks to respond, and several actions are being developed internationally.

One of the most important projects is the one leaded by the Rockefeller Foundation called “100 Resilient Cities”. In this framework, the adaptation of the urban environment to the increase of the average temperature pass through the minimization of the heat island effect taking advantage of the renewal of the urban skin to apply cool pavements and green roofs, wWhile the adaptation to the extreme rain events pass through the Sustainable Drainage Systems (SuDS) included in the Low Impact Development (LID) and Water Sensitive Urban Design (WSUD) philosophies.

Knowing these techniques, it is fundamental to be able to take the suitable decisions with a clear list of criteria and priorities. Geographical Information Systems (GIS) play a paramount role in the urban management and future planning, allowing the analysis and discussion of the possible actions to implement in the built environment.

Finally, the sustainability of the whole set has to be evaluated and controlled. For this purpose, Smart Cities offer a huge amount of data about the real use of resources and energies in our cities, making it possible to discuss if the resilience and needed adaptation to the Climate Change is related to sustainability.

Recommended Requirements:

Basic knowledge about sustainable concepts in design, construction and managements of buildings and infrastructures.

Basic competences:

- Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
- Students are able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
- Students are able to integrate knowledge and deal with the complexity of making judgments based on information that is incomplete or limited, including reflections on the social and ethical responsibilities associated with applying their knowledge and judgments.
- Students are able to communicate their findings and the ultimate knowledge and reasons behind them to specialist and non-specialist audiences in a clear and unambiguous manner.
- Students possess the learning skills to enable them to continue studying in a largely self-directed or autonomous manner.

Transverse competences:

At Master level, all the students are engineers or architects, being possible to discuss to them during the theoretical parts different approaches and points of view. For the same reason the exercises offer to the students analitical challenges instead of repetition or memory ones.

Specific competences:
To be able to design, build and manage sustainable and resilient infrastructure in the urban environment.

Learning outcomes:
Understand the importance of the resilience applied to the built environment.
Be acquainted with the techniques to deal with extreme temperatures in the built environment.
Be acquainted and apply the water sensitive urban design techniques.
Describe the main tools for urban management and apply GIS for decision-making.
Understand the smart city concept and its implications in the resources and energy management.

Content:
1. Resilient built environment: risks and actions.
2. Climate adaptive urban planning: heat island effect and cool pavements.
3. Low impact development (LID) and Water Sensitive Urban Design.
4. Urban management and GIS: tools for decision-making.
5. Sustainable built environment management: Smart cities, resources and energy.

Teaching methodology:
Interactive theoretical hours, using conventional oral presentations, but also video case studies and examples to discuss with students.
Practical hours are individual or group exercises on subjects that students must analyze and discuss, sometimes using specific software.
The evaluation is done in class, taking into account the students' participation during the theoretical classes and the presentation of results at the end of the individual or group exercises.

Training activities:

	Number of hours	% Attendance
Theory	30	100
Classroom practice	30	100
Tutorials	5	100
Evaluation	5	100
Group work	30	0
Self-directed work	50	0

Assessment method:

	Minimum weighting	Maximum weight
Continuous classroom evaluation	0%	40%
Final written work	0%	30%
Oral presentation	0%	30%
Practical exercises	0%	60%

Grading system:

U.PORTO	20	19	18	17	16	15	14	13	12	11	10	9	...	0
Portugal	Very Good with distinction			Good with distinction		Good		Sufficient				Fail		
U.CANTABRIA	10.0	9.9	9.0	8.9	...		7.0	6.9	...		5.0	4.9	...	0.0
Spain	Sobresaliente			Notable				Aprobado				Suspenso		
THM	100	...	88	87	73	72	58	57	...		50	49	...	0
Germany	Excellent			Good with distinction		Satisfactory		Sufficient				Fail		

Bibliography:

Rockefeller Foundation (2017) 100 Resilient Cities. Resources. http://www.100resilientcities.org/resources
Berkeley Lab (2017) Heat Island Group. Publications. https://heatisland.lbl.gov/publications
CIRIA (2017) Guidance on the construction of SuDS (C768) https://www.ciria.org/
UrbanGIS (2017) International Workshop on Smart Cities and Urban Analytics https://wp.nyu.edu/urbangis/
SmartCity (2017) Expo World Congress. Circular Economy http://www.smartcityexpo.com/en/

Current Status: 20200717