COURSE OUTLINE

1. GENERAL

SCHOOL	POLYTECHNIC		
DEPARTMENT	ARCHITECTURE		
LEVEL OF COURSE	UNDERGRADUATE		
COURSE CODE	ARC_E408	**SEMESTER OF STUDIES**	8th
COURSE TITLE	SPECIAL TOPICS ON SUSTAINABLE DESIGN		

INDEPENDENT TEACHING ACTIVITIES *σε περίπτωση που οι πιστωτικές μονάδες απονέμονται σε διακριτά μέρη του μαθήματος π.χ. Διαλέξεις, Εργαστηριακές Ασκήσεις κ.λπ. Αν οι πιστωτικές μονάδες απονέμονται ενιαία για το σύνολο του μαθήματος αναγράψτε τις εβδομαδιαίες ώρες διδασκαλίας και το σύνολο των πιστωτικών μονάδων*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	2	4
Προσθέστε σειρές αν χρειαστεί. Η οργάνωση διδασκαλίας και οι διδακτικές μέθοδοι που χρησιμοποιούνται περιγράφονται αναλυτικά στο 4.		

COURSE TYPE *Υποβάθρου , Γενικών Γνώσεων, Επιστημονικής Περιοχής, Ανάπτυξης Δεξιοτήτων*	Specialized knowledge Skills development
PREREQUISITE COURSES:	Sustainability and Environment 1 & 2 Sustainable Design
TEACHING AND ASSESSMENT LANGUAGE:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	
COURSE WEBPAGE (URL)	

2. LEARNING OUTCOMES

Leraning outcomes

Περιγράφονται τα μαθησιακά αποτελέσματα του μαθήματος οι συγκεκριμένες γνώσεις, δεξιότητες και ικανότητες καταλλήλου επιπέδου που θα αποκτήσουν οι φοιτητές μετά την επιτυχή ολοκλήρωση του μαθήματος.

Συμβουλευτείτε το Παράρτημα Α (ξεχωριστό αρχείο στο e-mail)

- *Περιγραφή του Επιπέδου των Μαθησιακών Αποτελεσμάτων για κάθε ένα κύκλο σπουδών σύμφωνα με Πλαίσιο Προσόντων του Ευρωπαϊκού Χώρου Ανώτατης Εκπαίδευσης*
- *Περιγραφικοί Δείκτες Επιπέδων 6, 7 & 8 του Ευρωπαϊκού Πλαισίου Προσόντων Διά Βίου Μάθησης*

και Παράρτημα Β

- *Περιληπτικός Οδηγός συγγραφής Μαθησιακών Αποτελεσμάτων*

On successful completion of the course, students will be able to:

- Demonstrate a critical understanding of the different criteria of environmental design assessment and of the basic methodology for evaluating environmental performance of built structures.
- Demonstrate a global understanding of the main approaches to environmental assessment in relation to design and construction.
- Demonstrate a broad understanding of various methods and tools for monitoring, modeling and simulating environmental conditions and performance of built structures and a critical understanding of their benefits and limitations.
- Demonstrate a practical understanding of the application of contemporary tools for design optimization in terms of environmental performance and sustainability.

General Abilities

Λαμβάνοντας υπόψη τις γενικές ικανότητες που πρέπει να έχει αποκτήσει ο πτυχιούχος (όπως αυτές αναγράφονται στο Παράρτημα Διπλώματος και παρατίθενται ακολούθως) σε ποια / ποιες από αυτές αποσκοπεί το μάθημα;.

Αναζήτηση, ανάλυση και σύνθεση δεδομένων και *Σχεδιασμός και διαχείριση έργων*

πληροφοριών, με τη χρήση και των απαραίτητων τεχνολογιών *Προσαρμογή σε νέες καταστάσεις* *Λήψη αποφάσεων* *Αυτόνομη εργασία* *Ομαδική εργασία* *Εργασία σε διεθνές περιβάλλον* *Εργασία σε διεπιστημονικό περιβάλλον* *Παράγωγή νέων ερευνητικών ιδεών*	*Σεβασμός στη διαφορετικότητα και στην πολυπολιτισμικότητα* *Σεβασμός στο φυσικό περιβάλλον* *Επίδειξη κοινωνικής, επαγγελματικής και ηθικής υπευθυνότητας και ευαισθησίας σε θέματα φύλου* *Άσκηση κριτικής και αυτοκριτικής* *Προαγωγή της ελεύθερης, δημιουργικής και επαγωγικής σκέψης*

- Search for, analysis and synthesis of data and information with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Respect for the natural environment
- Criticism and self-criticism
- Communication skills
- Capacity for critical thinking

3. COURSE CONTENT

The course focuses on environmental design evaluation methodology through measurable criteria, monitoring and simulation. It introduces methods, tools and techniques for the monitoring of outdoor and indoor climate conditions, the creation and calibration of microclimate and building simulation models, the simulation of existing and projected conditions to assess outdoor comfort, built structures environmental performance and energy efficiency. The main objective of the course is to document the relation of sustainability issues with the built environment through the study of microclimate influence on built structures, building energy efficiency improvement, outdoor comfort in urban sites and climate change impacts on existing and forthcoming buildings and sites. The course will offer students a broad understanding of environmental monitoring, simulation methodology and pertinent practices applicable to buildings and open spaces, providing them with the essential tools for documenting design proposals' assessment.

On-site monitoring and digital simulation methods and tools are approached as a process of assessing existing and future conditions in built environments and structures, in terms of objective criteria and quantifiable indices, associated with sustainability including environmental and anthropogenic parameters. Processes of monitoring, modeling, simulation, and results interpretation are demonstrated through a variety of tools as different options for analytic assessment. In particular, the simulation method is viewed as the means to identify design effects in future or proposed scenarios and provide feedback to optimize design and support decision making.

Basic concepts and key parameters of monitoring and simulation methodology are presented along with various alternative and complementary tools and applications for practical assessment. These comprise of climate analysis tools, solar calculators, thermal comfort models, building thermal and energy performance simulation models, daylight analysis tools, airflow and wind field analysis models, microclimate simulation tools etc. Short exercises with basic computational and analytic tools will take place as initial engagement and a more comprehensive approach will follow with an extended exercise on a case study evaluation (e.g. building performance evaluation of daylight factors, energy demands and carbon emissions or microclimate development and outdoor comfort assessment).

The course combines lectures followed by tools demonstration to engage students in short exercises with computational tools and techniques, literature review and an environmental design evaluation case study (selection of criteria, tools and method and presentation of assessment results)

Weekly topics

1. Introduction: Environmental design assessment criteria and methods. Monitoring - Calibration - Simulation - Design optimization and feedback loop. Final report assignment.
2. Climate assessment: climate data acquisition and interpretation.
3. On-site monitoring methods and equipment.
4. Solar geometry calculation tools and design implications: insolation and shading assessment for design optimization.

5. Thermal comfort assessment methods and tools.
6. Outdoor microclimate development, critical parameters, evaluation methods and simulation tools.
7. Outdoor microclimate development, critical parameters, evaluation methods and simulation tools.
8. Building energy balance and energy performance criteria. Energy performance simulation methods and tools.
9. Building energy balance and energy performance criteria. Energy performance simulation methods and tools.
10. Daylight and visual comfort in buildings. Daylight assessment methods and simulation tools.
11. Airflow and wind field in relation to comfort, pollutant dispersion and indoor air quality. Evaluation methods and simulation tools.
12. Life Cycle Analysis and Building Information Modeling tools
13. Final report presentations and discussion

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Πρόσωπο με πρόσωπο, Εξ αποστάσεως εκπαίδευση κ.λπ.*	Face to face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Χρήση Τ.Π.Ε. στη Διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές*	Use of ICT in teaching and communication with students. Support of learning through the e-learning platform e-class. Demonstration of use of software for modeling and simulation.
TEACHING ORGANIZATION *Περιγράφονται αναλυτικά ο τρόπος και μέθοδοι διδασκαλίας.* *Διαλέξεις, Σεμινάρια, Εργαστηριακή Άσκηση, Άσκηση Πεδίου, Μελέτη & ανάλυση βιβλιογραφίας, Φροντιστήριο, Πρακτική (Τοποθέτηση), Κλινική Άσκηση, Καλλιτεχνικό Εργαστήριο, Διαδραστική διδασκαλία, Εκπαιδευτικές επισκέψεις, Εκπόνηση μελέτης (project), Συγγραφή εργασίας / εργασιών, Καλλιτεχνική δημιουργία, κ.λπ.* *Αναγράφονται οι ώρες μελέτης του φοιτητή για κάθε μαθησιακή δραστηριότητα καθώς και οι ώρες μη καθοδηγούμενης μελέτης ώστε ο συνολικός φόρτος εργασίας σε επίπεδο εξαμήνου να αντιστοιχεί στα standards του ECTS*	

Δραστηριότητα	***Φόρτος Εργασίας Εξαμήνου***
Lectures – short exercises	24
Presentations	2
Independent study -Bibliographical research – Final report	24
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***50***

STUDENT ASSESSEMNT *Περιγραφή της διαδικασίας αξιολόγησης* *Γλώσσα Αξιολόγησης, Μέθοδοι αξιολόγησης, Διαμορφωτική ή Συμπερασματική, Δοκιμασία Πολλαπλής Επιλογής, Ερωτήσεις Σύντομης Απάντησης, Ερωτήσεις Ανάπτυξης Δοκιμίων, Επίλυση Προβλημάτων, Γραπτή Εργασία, Έκθεση / Αναφορά, Προφορική Εξέταση, Δημόσια Παρουσίαση, Εργαστηριακή Εργασία, Κλινική Εξέταση Ασθενούς, Καλλιτεχνική Ερμηνεία, Άλλη / Άλλες* *Αναφέρονται ρητά προσδιορισμένα κριτήρια αξιολόγησης και εάν και που είναι προσβάσιμα από τους φοιτητές;*	Methods of evaluation: Participation and engagement in lectures and short exercises (30%), final public presentations (30%), and final report submission (40%). The short exercises consist of individual familiarisation exercises on specialised software and tools and the final report consist of an environmental design evaluation of a case study building or site.

5. RECOMMENDED LITERATURE

-Recommended literature:

- Dekay, Mark & Z Brown, G., Susanne Bennett (ed), (2014). Sun, Wind & Light: architectural design strategies, Wiley,3rd edition
- Erell, E., D. Pearlmutter, and T. Williamson (2011). Urban Microclimate – Designing the Spaces between Buildings. Earthscan. ISBN 978-1-84407-467-9

- Robinson, D. (2011). Computer Modelling for Sustainable Urban Design. Physical Principles, Methods and Applications. Earthscan. ISBN 9781844076796
- Baker, N. and K. Steemers (2002). Daylight design of buildings. James and James
- Littlefair, P.J. (2011) Site Layout Planning for Daylight and Sunlight. A Guide to Good Practice. BRE Press University
- Boardman, B. (2012). Achieving Zero Delivering Future-friendly Buildings. Oxford
- Mauree, D., E. Naboni, S. Coccolo, A.T.D. Perera, V.M. Nik, J. L. Scartezzini (2019). A review of assessment methods for the urban environment and its energy sustainability to guarantee climate adaptation of future cities. Renewable and Sustainable Energy Reviews 112 (2019) 733–746. https://doi.org/10.1016/j.rser.2019.06.005
- Evola, G., V. Costanzo, C. Magrì, G. Margani, L. Marletta, E. Naboni (2020). A novel comprehensive workflow for modelling outdoor thermal comfort and energy demand in urban canyons: Results and critical issues. Energy and Buildings 216, 1 June 2020, 109946. https://doi.org/10.1016/j.enbuild.2020.109946.
- Antoniou, N., H. Montazeri, M. Neophytou, B. Blocken (2019). CFD simulation of urban microclimate: Validation using high-resolution field measurements. Science of the Total Environment 695 (2019) 133743. https://doi.org/10.1016/j.scitotenv.2019.133743
- Blocken, B. (2015). Computational Fluid Dynamics for urban physics: Importance, scales, possibilities, limitations and ten tips and tricks towards accurate and reliable simulations. Building and Environment 91 (2015) 219-245. http://dx.doi.org/10.1016/j.buildenv.2015.02.015
- Shinzato, P., H. Simon, D. H. Silva Duarte, M. Bruse (2019). Calibration process and parametrization of tropical plants using ENVI-met V4 – Sao Paulo case study, Architectural Science Review. https://doi.org/10.1080/00038628.2018.1563522
- Tsoka, S., K. Tsikaloudaki, T. Theodosiou. (2019). Coupling a Building Energy Simulation Tool with a Microclimate Model to Assess the Impact of cool Pavements on the Building's Energy Performance. Application in a Dense Residential Area. Sustainability, 11(9), 2519. https://doi.org/10.3390/su11092519
- Baeza, J. L., Sievert, J. L., Landwehr, A., Luft, J., Preuner, P., Bruns-Berentelg, J., Noyman, A., & Noennig, J. R. (2021). CityScope Platform for Real-Time Analysis and Decision-Support in Urban Design Competitions. International Journal of E-Planning Research (IJEPR), 10(4), 121-137. http://doi.org/10.4018/IJEPR.20211001.oa8
- Fröhlich, D., Matzarakis, A, 2018: Spatial Estimation of Thermal Indices in Urban Areas—Basics of the SkyHelios Model. Atmosphere 2018, 9, 209, 1-14. https://doi.org/10.3390/atmos9060209
- Matzarakis, A., 2012: Linking urban micro scale models - The models RayMan and SkyHelios. Proceedings of the 8th International Conference on Urban Climates and the 10th Symposium of the Urban Environment, No. 136, 1-4.

-Relevant websites:

- https://meteonorm.com/
- https://www.envi-met.com/
- https://designbuilder.co.uk/
- https://www.edsl.net/ambiens-2d/
- https://www.iesve.com/
- https://www.autodesk.com/products/revit/
- https://www.ansys.com/products/fluids/ansys-fluent
- https://leeduser.buildinggreen.com/browse
- https://energy-design-tools.sbse.org/
- https://www.sbse.org/resources
- http://andrewmarsh.com/
- https://www.sunearthtools.com/
- https://www.urbanclimate.net/rayman/
- https://www.urbanclimate.net/skyhelios/
- https://comfort.cbe.berkeley.edu/
- http://www.utci.org/index.php
- https://energyplus.net/
- https://www.openfoam.com/
- https://www.radiance-online.org//
- https://www.dialux.com/en-GB/
- https://openstudio.net/
- https://www.grasshopper3d.com/
- https://www.ladybug.tools/

- https://www.ladybug.tools/honeybee.html
- https://www.ladybug.tools/butterfly.html