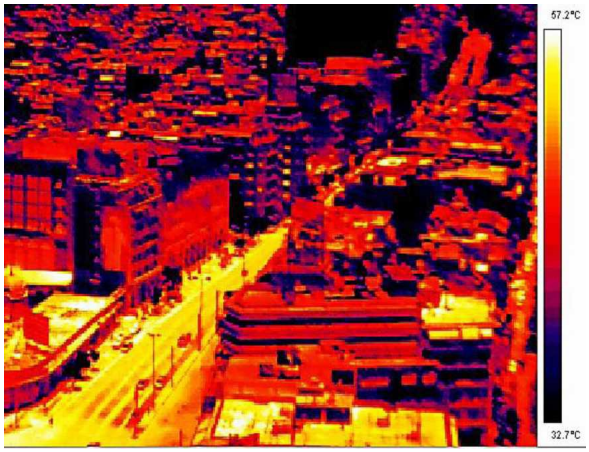
UNSW SYDNEY | Australia's Global University

Built Environment

ARCH7218
Urban Climate Change – Mitigation and Adaptation in the Urban Built Environment

Professor Mattheos Santamouris



3+ Abbreviated Course Outline – T2

Disclaimer
This abbreviated course outline is indicative of the outcomes, delivery and assessment. While Course Learning Outcomes will remain constant, other details may be subject to change. The full and most accurate course outline will be available in Moodle.

1. COURSE STAFF

Course Convenor	Professor Mattheos Santamouris
Email	m.santamouris@unsw.edu.au
Phone	9385 0729
Consultation	By appointment – organise via email

2. COURSE DETAILS

Credit Points	6 units of credit (uoc)
Workload	Approx. 150 hours including class contact hours, weekly individual and group online learning activities, readings, class preparation, and assessment activities.
Teaching Times and Location	Find details in timetable http://www.timetable.unsw.edu.au

Description

This course will focus on the urban climate problems and the relevant mitigation and adaptation design techniques and technologies to counterbalance the temperature increase in the urban built environment. The first part of the course, will explore the major issues around the climate of cities, will offer advanced knowledge on the interaction between the urban climate, buildings and open spaces, and will analyse the main impact of local climate change on energy, indoor and outdoor thermal comfort, health and economy. The second part of the course will explore, analyse and present in details the major mitigation and adaptation design techniques and technologies to counterbalance the urban temperature increase. It will investigate and present issues related to the appropriate use of materials in cities, new advanced and cutting edge materials for open spaces and buildings, heat dissipation and amortization technologies for buildings and open spaces based on the use of low temperature environmental sinks, smart energy and environmental management technologies for cities, Anthropogenic heat avoidance technologies and all aspects related to the proper use of urban greenery in the urban built environment. Examples from successful real case studies will be presented. Modelling techniques (i.e. ENVI-met) to simulate the thermal characteristics of cities and evaluate the impact of the main mitigation and adaptation technologies will presented, analyzed and used by the students. Students will also learn how to use energy simulation techniques (i.e. Design Builder) and analyze the impacts of heat mitigation strategies on energy consumptions.

Program Learning Outcomes (PLOs)
This course addresses the following MArch Program Outcomes:

1. Create and develop compelling architectural proposals that synthesise disciplinary knowledge and professional competencies with an ambition to support the wellbeing of society.
2. Demonstrate independent skills in architectural enquiry through research, analysis, critique and reflection.
3. Apply advanced communication skills which are precise, persuasive and creative using a variety of methods and media.
4. Exercise informed ethical judgement in scholarship and architectural practice.
5. Demonstrate the ability to work collegially and productively in teams encompassing diverse cultural and disciplinary affiliations.

Course Learning Outcomes (CLOs) with Alignment to PLOs and Assessment

CLO #	CLO Statement	PLO #	Assessment(s)
CLO 1	Understand the major climatic phenomena and mechanisms in the urban environment affecting the performance of urban buildings and open spaces	1, 2,3,5	Project 1
CLO 2	Be able to compute and analyse the specific impact of the urban climate on the energy consumption of buildings, thermal comfort and the global environmental performance of the urban built environment	1,2,4,5	Project 2
CLO 3	Understand and apply advanced mitigation and adaptation techniques and technologies to design and enhance the performance of urban buildings and urban structures counterbalancing the urban climate change	1,2,3,4,5	Project 3
CLO 4	Perform simulations and apply advanced computational methods to optimise the environmental design of urban buildings and open spaces and minimize their environmental impact.	2,3,4	Project 4

3. ASSESSMENT

Assessment Task	Weight	CLOs Assessed	PLOs Assessed	Due Date
1. A review and report on urban climate phenomena and the impact of local climate change on energy comfort and environmental quality	20%	1	1, 2, 3	Week 3
2. A report of field monitoring and measurement (Students will perform indoor and outdoor field measurement in UNSW main campus and interpret the results and check compliance with existing standards)	20%	1,2	3,4,5	Week 5
3. Preliminary results of Simulations (Students will preform simulations of the existing condition in a precinct near UNSW campus and submit the results	20%	2,3	2,3,4	Week 7

and interpret the findings)				
4. Final submission, report and simulations outcome (Students will perform simulations with ENVI-met and Design Builder and apply mitigation and adaptation technologies, they interpreted the results and submit the outcome. Students will require to also present orally as part of final assessment)	40%	1,3,4	1,2,3,4	Week 10

4. WEEKLY COURSE SCHEDULE

Week	Learning Activity	Assessment Submissions	Related CLOs
1	**Introduction to Urban Climate** Temperature distribution and air flow phenomena in cities. The climate around buildings. Description and analysis of the heat Island and urban canyon phenomena. Thermal comfort models for outdoor urban spaces. • Students should read the study material prior to class		1
2	**Impact of Urban Climate and Local Climatic Change** Analysis of the impact of the local climate change on the energy consumption of buildings, indoor and outdoor thermal comfort, health, vulnerability levels, pollution, economy and global environmental quality. • Students should read the study material prior to class • Students start modelling of the urban environment and building modeling in the tutorial		1
3	**Results and Conclusions from Selected Cities** Presentation of specific studies on the energy, comfort and vulnerability impact of local and global climate change in selected cities. Quantitative and qualitative results • Students should read the study material prior to class • Students proceed with simulation training • Students perform site measurements	Assignment 1 Due Weighting: 20%	1,2
4	**Methodologies to Compute the Energy Impact of Local Climate Change.** Presentation of the main computational methodologies to assess the energy impact of local and global climate change in individual buildings and cities.		1,2

	• Students should read the study material prior to class • Students proceed with simulations training • Students discuss the simulation model in the tutorial • Students discuss the report of site measurement in the class		
5	**Methodologies to Compute and Measure Outdoor Thermal Comfort Conditions.** Presentation of the main monitoring methodologies to assess the thermal quality and the levels of outdoor thermal comfort in cities. Presentation of the main theoretical methods to compute the levels of outdoor thermal comfort. Adaptive thermal comfort. • Students proceed with modelling of the urban environment in the tutorial • Students discuss the simulation model in the tutorial	Assignment 2 Due Weighting: 20%	1,2,3
6	**Introduction to Urban Mitigation and Adaptation Techniques. The Role of Materials** Definition of Mitigation and Adaptation Techniques for individual Urban buildings and open spaces. Presentation of the state of the art on advanced materials to mitigate urban climate change. Cool and smart materials Cool Roofs and Cool Pavements. Examples and Case Studies. • Students should read the study material prior to class • Students discuss the simulation in the tutorial • Students discuss the adaptation and mitigation technologies in the tutorial		3
7	**Introduction to Urban Mitigation and Adaptation Techniques. Heat dissipation Technologies** Mitigation techniques using the ground as a heat sink. Urban ventilation technologies for buildings and open spaces. The use of water as a heat sink for dissipation. Examples and Case studies. • Students should read the study material prior to class • Students proceed with modelling of the urban environment in the tutorial • Students discuss the simulation model in the tutorial	Assignment 3 Due Weighting: 20%	2,3
8	**Topic Introduction to Urban Mitigation and Adaptation Techniques. Use of Green Spaces for Mitigation of the Urban Heat** Analysis of the impact of urban green on the urban ambient temperature. The impact of urban parks in the overall temperature distribution of cities. The main characteristics and benefits of the green roof techniques. The thermal balance of green roofs. Examples and case studies.		3,4

	• Students proceed with modelling of the urban environment in the tutorial • Students discuss the simulation model in the tutorial		
9	**Topic Presentation of Case Studies involving Integrated Urban Mitigation Technologies** Presentation and Analysis of the main quantitative and qualitative characteristics of existing urban case studies where integrated urban mitigation and adaptation techniques are applied. • Students discuss the simulation results in the tutorial		1,3,4
10	**Introduction to Computational Models to Assess the Thermal Performance of Urban Spaces** Presentation of the various empirical and deterministic theoretical models to assess the thermal performance of urban areas. Advantages and Disadvantages of the existing computational tools. Examples and Results from existing applications	Assignment 4 Due Weighting: 40%	1,3,4