Syllabus for 4.430 Daylighting (version May. 31, 15)

Spring 2015

Department:	Architecture
Instructor:	Christoph Reinhart (creinhart@mit.edu) Office hours: By appointment
Teaching Assistants:	Jeff Geisinger (jgeis01@mit.edu)
Time & Location:	Lectures: Tu & Th 9:30 - 11:00, MIT Room 3-113 Lab: Th 11.00 – noon, MIT Room 9-250
Prerequisites:	Introductory Course on Building Science or permission by instructor
What you will need:	PC with Rhino V5 SR10 or higher

Course Description

The United Nations General Assembly has declared 2015 to be the International Year of Light. The time is right to learn all about the role of daylight and electric lighting in shaping architecture. This course promotes the integration of occupant comfort, energy efficiency and daylight availability throughout the design process and covers a series of design techniques from rules of thumb and simulations to high dynamic range photography and physical model building.

Throughout the course students will work in groups and apply these techniques to a semester-long course project. The course projects will be determined in discussion with the instructor. In order to develop a feeling for the physical quantities related to light and daylight, students will initially measure, simulate and evaluate the daylighting in a local space. Students will then build a massing model of their project and test it in a heliodon. The simulation environment used throughout the course will be a Rhino plug-in for daylighting and energy analysis called DIVA-for-Rhino. It is based on Radiance, Daysim and EnergyPlus. Students will need a copy of Rhino V5.0 SR10 or higher to use the plug-in on their computer.

The course has a track-record of spawning innovation from a GreenBuild 2008 Educational Session, when course projects were presented to 400 practitioners, to the original development of the DIVA-for-Rhino tool in 2010 and Urban Daylight in 2012. This time we will be concentrating on the analysis and design of automated lighting and shading controls for dynamic, high performance facades. Apart from regular lectures and a weekly lab, we will have several guest lecturers from the Harvard Medical School as well as from practitioners in order to broaden the students' understanding of light and its impact on human health and performance. This is a 9 or 12 credit graduate class. Undergraduate students are very welcome.

Learning Objectives

At the end of this course students will be able to …

- formulate their own definition of what constitutes 'good ' lighting,
- conduct a series of daylighting design techniques from rules of thumb and simulation to high dynamic range photography and physical model building,
- develop a comprehensive lighting strategy for their projects.

Requirements

Attendance of all lectures is mandatory. A series of assignments will help students to work on their course projects throughout the term. Students are expected to give a short midterm presentation on their projects in class on April 2nd. Final presentations will be on r will provide feedback for the students to consider for their final presentations on May 5th and May 7th. Slides from the midterm and final presentations have to be submitted at least an hour before the presentations start.

Methods of Assessment

Grades will be determined based on the quality and quantity of completed assignments, participation in class discussions, and the quality of the two course presentations. Class participation, assignments, midterm and final presentations will be worth 10%, 50%, 15% and 25% of your grade, respectively, for a total of 100%. Midterm and final presentations will be graded based on the

- clarity of the project's (day)lighting objectives,
- originality and inner logic of the design techniques used,
- comprehensiveness of the final design solution and
- overall quality of the presentation.

Readings

The main textbook for this class in the *Daylighting Handbook I* written by the course instructor (http://daylightinghandbook.com/). A course reader will further be provided to enrolled students at the beginning of the term. Suggested further readings are:

W Lam, *Sunlighting as Formgiver for Architecture*, Van Rostrand Reinhold Company, New York, 1986. Available online at http://www.wmclam.com.

M Rea, *IESNA Lighting Handbook*, reference book published by the Illuminating Engineering Society of North America, 9th Edition, 2000.

M Guzowski, *Daylighting for Sustainable Design*, McGrawHill, 1999 (lots of case studies).

J Tanizaki, 1977, In Praise of Shadows, Leete's Island Books, Sedgwick, ME, USA.

Academic Integrity

If required please re-familiarize yourself with the MIT Academic Integrity handbook that can be downloaded from http://web.mit.edu/academicintegrity/.

Week	**Tuesday Lecture** (9.30 – 11.00, 3-133)	**Thursday Lecture** (9.30 – 11.00, 3-133)	**Thursday Lab** (11.00 – noon, 9-250)	**Reading**[§]	**Assignment** (due date, to be submitted to Stella before class)
1	**Feb 3 Introduction to Daylighting; Goal Setting and Implementation**	**Feb 5 Designing for Daylight; The Source**	No lab	DH1 Introduction DH2 Designing for Daylight DH3 The Source	A1 What is Daylighting? (Feb 5)
2	**Feb 10 Circadian Effects of Light** (Shadab Rahman, Harvard Medical School)	**Feb 16 The Sensor & Basic Photometry**	HDR & Photometry Workshop	Lockley Chapter (CR) DH4 The Sensor HDR Workshop[**] (Inanici)	A2 Daylit Area Study & Basic Photometry; Drawing study (Feb 19)
3	**Feb 17: Monday classes due to President's Day** (no class)	**Feb 19: Massing Studies; Where is the Sun?**	Introduction to DIVA & Ladybug	DH5 Massing Studies DH6 Where is the Sun? Daylight Pattern Guide	A3 Shading Studies and Sun Chart Diagrams (Feb 26)
4	**Feb 24: Radiation Maps; Designing Static Shading Systems**	**Feb 26: Physical Model Building and Theory; Introduction to Heliodon Measurements**	DIVA Radiation Maps; ArchSim/Viper/ Shaderade	DH9 (draft chapter, CR) DH7 Static Shading Systems DM8 Scale Models	A4 Designing a Static Shading System (Mar 5)
5	**Mar 3: Scale Model Building Workshop** (J Geisinger)	**Mar 5: Daylight Simulation Methods**	Heliodon Study (atrium Building 10)	DH10 (draft chapter, CR) Scale Model Building (CR)	A5 Heliodon Study (Mar 12)
6	**Mar 10: Daylight Availability Metrics**	**Mar 12: Light and Matter – Modeling Complex Materials**	**Mar 12 Lab:** Advanced material definitions **Fr:** Group meetings with instructor	LEUKOS Metrics Paper LM83 Daylight Metrics Radiance Reference Manual SDL Measurement Brochure	A6 Rendering with Radiance: Simulation Parameters & Complex Materials (Mar 20)
7	**Mar 17 Tour of MIT Dome** (Bldg 10; Tour by G Tondorf-Dick)	**Mar 19 Radiance Review** (J Geisinger; Instructor traveling)	**Radiance Review continued**		A7 Daylight Availability Study (Apr 2)
8	**Spring Vacation**				
9	**Mar 31: Visual Comfort & Glare**	**Apr 2: Midterm Presentations:** Static Facades – Energy, View and Daylight Availability Studies	Visit Thomas Auer		
10	**Apr 7: Exterior Glare; Occupant Behavior & Dynamic Shading**	**Apr 9: No class** (makeup lecture on April 21)	DIVA Glare and Dynamic Shading Module	BPS Chapter 9 (pp 264 - 270)	A8 Glare Analysis & Design of a Dynamic Shading System (Apr 16)
11	**Apr 14: Envelope Design and Interior Partitions**	**Apr 16: Electric Lighting Systems**	DIVA Electric Lighting		A9 Electric Lighting Study plus cut sheets (Apr 23)
12	**Apr 21: Lighting Controls**	**Apr 23: Integrated Lighting Thermal Simulations**	DIVA electric lighting; THERM Analysis	THERM Tutorial (CR)	A10 Integrated Lighting/Energy Study (Apr 30)
13	**Apr 28: Programming Electric Lighting Controls- Visit Medial Lab**	**Apr 30: Shading System Controls and Motors**			
14	**May 5: Meeting with instructor**	**May 7: Final Presentations**	Reviewer: C Sampson; E. Transsolar, Happold, ARUP		
15	**May 12:** (no class)	**May 14:** Field Trip to Philips Color Kinetics			

[§] DH = Daylighting Handbook I; CR= Course Reader

[**] Radiance Workshop Slides 2009 by M. Inanici, please download from www.radiance-online.org/radiance-workshop8/Presentations/inanici_HDR-2009.pdf