CIEE Global Institute – Berlin

Course name:	Science and Technology Workshop - Computational Design Theory and Application
Course number:	ARCH 3102 BRGE
Programs offering course:	Berlin Global Architecture and Design
Language of instruction:	English
U.S. semester credits:	3
Contact hours:	45
Term:	Fall 2018

Course Description

In this Science and Technology workshop, students will learn computational design theory and application with Rhinoceros and Grasshopper. Designer increasingly need to create reactive and flexible environments which are efficient and adaptive at the same time and capable to integrate diverse and competing requirements. Computational design tools, especially when paired with environmental data sources enable provide multi-performative solutions which handle the complexity of multi-factorial demands and diverse environments of the present and often reach out into the future as an enabler/catalyst. Rather than masterful command of specific tools, this course investigates the intersection of technologies and benefits of platforms. The instructional goal of the course is therefore to exhibit judgement in utilizing media for purpose, rather than rely purely on calculus.

Learning Objectives

By the end of the course, students will be able to:

- communicate ideas critically about a multi-systemic approach to

design in an existing climatic and urban context and the implementation of information and communication technologies.

- identify alternative ways for urban understanding and making.
- work effectively in a group using new technologies applied in urban context.
- assess data gained from various analysis tools or external data sets.
- apply data sets to drive the generation of form and to develop behavioral morphological form families.
- optimize their design and choose the most suitable strategy for production of a prototype.
- document their design for execution and how to prepare digital files required for cnc aided manufacturing.
- use Nurbs Modeling and parametric/scripting tools in the design and simulation process.
- design more efficient and sustainable cities and public spaces.
- exhibit sound decision making in the application of tools and technology.

Course Prerequisites

Basic 3D modeling skills. Students in the Open Campus program must submit work examples for review by the Global Programs Coordinator prior to enrolling.

Methods of Instruction

In-class slide lectures and desk critiques of project development; hands-on software training. Software includes the free-form 3d modeling tool Rhinoceros3d and the parametric scripting environment Grasshopper3d.

Software Requirements

- Rhino 5 64-bit on Windows or using Bootcamp on Mac OS (do *not* use native version on Mac), with latest version of Grasshopper.
- Python for Grasshopper (available through the “Online References” below).

Assessment and Final Grade

Participation in Class	20%
Workshop Progress	20%
Homework Assignments	20%
Transfer and Application	40%

Course Requirements

Participation in Class

Students engage in class discussions and participate in team work and field research

Workshop Progress

Students follow the workshop instructor during hands-on training sessions. It's important that students pay close attention complete the in-class task. In the workshop students will learn various methods and techniques to develop tailor-made geometrical systems that are correlating to form a complex multi-systemic approach to design which integrates the various aspects of the contemporary city (fabric modulation, street systems, open spaces, functionality, tectonic articulation, performance, lifecycle etc.)

Homework Assignments
Weekly homework assignments reinforce the in-class training.

Transfer and Application
A term assignment demonstrates that students can transfer and apply their new skills to solve a design challenge.

Participation
As part of your work in this course, students should demonstrate learning beyond the submission of written assignments or presentations. As such, all students receive grades based upon participation.

Participation is valued as meaningful contribution in the digital and tangible classroom, utilizing the resources and materials presented to students as part of the course. Students receive grades based upon their contributions both in the classroom and in the Canvas course.

Meaningful contribution requires students to be prepared, as directed by the Instructor, in advance of each class session. Students must clearly demonstrate they have engaged with the materials where directed.

This includes valued or informed engagement in, for example, small group discussions, online discussion boards, peer-to-peer feedback (after presentations), interaction with guest speakers, and attentiveness on co-curricular and outside-of-classroom activities.

Attendance Policy
Regular class attendance is required throughout the program, and all unexcused absences will result in a lower participation grade for any affected CIEE course. Due to the intensive schedules for Open Campus and Short Term programs, unexcused absences that constitute more than 10% of the total course sessions will also result in a lower final grade.

Students who transfer from one CIEE class to another during the add/drop period will not be considered absent from the first session(s) of their new class, provided they were marked present for the first session(s) of their original class.

Otherwise, the absence(s) from the original class carry over to the new class and count against the grade in that class.

For CIEE classes, excessively tardy (over 15 minutes late) students must be marked absent. Attendance policies also apply to any required co-curricular class excursion or event, as well as to Internship, Service Learning, or required field placement. Students who miss class for personal travel will be marked as absent and unexcused. No make-up or re-sit opportunity will be provided.

An absence in a CIEE course will only be considered excused if:

- a doctor's note is provided
- a CIEE staff member verifies that the student was too ill to attend class
- satisfactory evidence is provided of a family emergency

Attendance policies also apply to any required class excursion, with the exception that some class excursions cannot accommodate any tardiness, and students risk being marked as absent if they fail to be present at the appointed time.

Unexcused absences will lead to the following penalties:

Percentage of Total Course Hours Missed	*Equivalent Number of Open Campus Semester classes*	*Minimum Penalty*
Up to 10%	1	No academic penalty
10 – 20%	2	Reduction of final grade
More than 20%	3 content classes, or 4 language classes	Automatic course failure, and possible expulsion

Weekly Schedule

NOTE: The workshop is structured in a series of exercises. Time and duration of the exercises will be dependent on the level of digital modeling skills of participants.

Session 1 **Topics:**

- Introduction to Rhinoceros
- User Interface
- Solids, Nurbs and Meshes
- Commands
- Curves and Curve tools
- Nurbs Surfaces
- History and simple parametric models

Session 2 **Topics:**

- Advanced Modeling Strategies
- Complex surfaces
- Editing surfaces
- Analyzing surfaces

Session 3 **Topics:**

- Documentation & manufacturing
- Drafting tools
- Layouts
- Generating 2D Drawings
- Print and Exports
- Preparing and exporting files for milling and 3d printing

Session 4 **Topics:**

- Introduction to Grasshopper
- Introduction to scripting

- User Interface
- Introductory examples

Session 5 **Topics:**

- Surface Tesselations
- Introduction to Tesselation
- Tesselations in grasshopper
- Tesselations using paneling tools
- Surface Population

Session 6 **Topics:**

- Component Design
- Introduction
- Component Design
- Attractor as Driver
- Data as Driver
- Morphological Studies

Session 7 **Topics:**

- Performance Optimization
- Introduction
- Environmental Performance
- Structural Performance

Session 8 **Topics:**

- Growth
- Introduction
- Zoning and growth
- Behavioral growth models: Loops and conditions

Sessions 9-12

Individual Project Support. The instructor will guide students on how to specially apply Rhino and Grasshopper to meet their project goals. In particular, digital fabrication will be discussed and students will learn how to develop their geometries for 3D printing and Milling in the Fab Lab.

Readings

AD – Architectural Design (Special Issue: Digital Cities), 79, no. 4, 2009.

_____. (Special Issue: Typological Urbanism: Projective Cities), 81, no. 1, 2011.

_____. (Special Issue: City Catalyst: Architecture in the Age of Extreme Urbanisation), 82, no. 5, 2012.

_____. (Special Issue: System City: Infrastructure and the Spaces of Flows), 83, no. 4, 2013.

_____. (Special Issue: Mass Customized Cities), 85, no. 6, 2015.

Kelbaugh, Douglas and Kit Krankell McCullough. *Writing Urbanism – A Design Reader.* London: Routledge, 2008.

Portugali, Juval, Han Meyer, Egbert Stolk, and Ekim Tan, eds. *Complexity – Theories of Cities Have Come of Age: An Overview with Implications to Urban Planning and Design*. New York: Springer, 2012.

Schumacher, Patrick. "Parametricism with Social Patterns," in Ionathan Lazovski and Yuval Kahlon (eds.), *The Human (Parameter) - Parametric Approach in Israeli Architecture*, London: 2015.

_____. "Parametricism – A New Global Style for Architecture and Urban Design," in Neil Leach & Philip Yuan (eds), *Scripting the Future*. Tongji University Press, 2012. First published in: *AD Architectural Design - Digital Cities*, 79, no 4, July/August 2009.

Payne, Andrew and Rajaa Isaa. *The Grasshopper Primer: For Version 0.6.0007*, second edition. 2009. Available through the "Online References" below.

Verebes, Tom. *Masterplanning – The Adaptive City, Computational Urbanism in the Twenty-First Century*. London: Routledge, 2013.

Online References

Grasshopper Tutorials
http://www.grasshopper3d.com/page/tutorials-1

Python for Grasshopper
http://www.food4rhino.com/