Department of Architectural Technology

ARCH 3590  PARAMETRIC COMPUTATION, MATERIALS AND FABRICATION
1 classroom hour, 4 lab/studio hours, 3 credits

Course Description: This course is an introduction to digital fabrication. In the context of computational design and digital fabrication thinking and techniques, the course will explore the qualities of materials such as wood, concrete, and plastics. Projects will provide students with experience in the use of a variety of tools, equipment, key concepts, and emerging digitally-driven technologies, including parametric rule-based design, subtractive fabrication, assembly techniques, and iterative design processes.

Course context: This course is one of three upper level electives available to AAS students.

Prerequisites: ARCH 1191 and ARCH 1291 both with a grade of C or higher

Required Text: Course Reader, to be available from Zip Publishing

Recommended Texts

Attendance Policy: No absences accounting for more than 10% of class time are permitted during the semester. For purposes of record, two latenesses are considered as one absence. Exceeding this limit will expose the student to failing at the discretion of the instructor.

Course Structure: This course will be offered as a lecture/lab format with readings/lectures as well as hands on tutorials that introduce computational concepts, techniques and methods needed for completion of projects for approximately the first third of the semester. After this, the course will focus increasingly on digital fabrication processes and assembly. Students will produce a series of three fabrication projects with the tools and techniques covered in the course that communicate ideas and incorporate data of increasing complexity.

Grading
Computation exercises 30%
Fabrication projects 50%
Reading Group Lecture/Presentations 10%
Class Participation 10%

Academic Integrity: Students and all others who work with information, ideas, texts, images, music, inventions and other intellectual property owe their audience and sources accuracy and honesty in using, crediting and citation of sources. As a community of intellectual and professional workers, the college recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and is punishable by penalties, including failing grades, suspension and expulsion.
Learning Objectives
Upon successful completion of this course, the student will:

1. **Understand** the differences between different fabrication processes. (Knowledge)
2. **Understand** the difference between parametric and traditional design methodologies. (Knowledge)
3. **Understand** the properties of different materials. (Knowledge)
4. **Understand** and **recall** the key terms, properties, and fabrication techniques of the materials reviewed in the lectures and readings. (Gen Ed)
5. **Develop** and **apply** a professional vocabulary of architectural terminology and professional conduct in workshop. (Gen Ed)
6. **Demonstrate** proficiency in preparing computational models for fabrication using a laser cutter. (Skill)
7. **Demonstrate** proficiency in preparing computation models for fabrication using a CNC mill. (Skill)

Assessment
To evaluate the students' achievement of the learning objectives, the professor will do the following:

1. **Review** the students' computational files for best practices for fabrication. (Los: 1, 2, 6, 7)
2. **Review** the students' models fabricated on the laser cutter and CNC mill for evidence of best practices and understanding of material properties. (Los: 1, 2, 3, 6, 7)
3. **Determine** the students' knowledge of key terms, properties, and fabrication techniques of the materials during class discussions. (Los: 4)
4. **Assess** the students' professional vocabulary and conduct during class exercises. (Los: 5)

Course Outline:

**WEEK 1**
*Introduction to Parametric Modeling*
- Grasshopper: Interface
- Parameter / Component Object Types
- UI Components-Introduction
- Operators, Conditionals, Logic, Lists
- Weekly Computation Assignment

*Material Presentation*
- Introduction to Natural Materials: Properties and Design Uses

*Reading*
- Achim Menges, “Instrumental Geometry” in *Fabricating Architecture* (Course Reader)
- Jean Grenier, “Natural Materials” & “Plastics” in *Industrial Design Techniques and Materials*

**WEEK 2**
*Reading Group I: Student presentation on prior week’s reading*
*Parametric Modeling Part 2*
- Point Geometry Primer
- Vector Geometry Primer
- Patterning with Attractors / Point, Vector, Curve, Surface, etc.
- Weekly Computation Assignment

*Material Presentation*
- Wood, Paper-based Materials, and Plexiglass

*Reading*
- Lars Spuybroek, “Introduction” in *The Architecture of Variation*, and
- Manuel de Landa, “Material Evolvability and Variability” in *Lars Spuybroek, The Architecture of Variation (Course Reader)*
- Jean Grenier, “So Which Material Should We Use” and “A Word About stock-Removal Technique” in *Industrial Design Techniques and Materials*
WEEK 3

**Reading Group II: Student presentation on prior week’s reading**

**Parametric Modeling Part 3**
- Curve Geometry Primer
- Data Trees Intro
- Data Tree Management
- Weekly Computation Assignment

**Fabrication Assignment I** : Laser Cutter Project Surface Unrolling and Assembly with Grasshopper files

**Reading**
- Preston Scott Cohen, “Introduction” in *Contested Symmetries and Other Predicaments in Architecture* (Course Reader)

WEEK 4

**Reading Group III: Student presentation on prior week’s reading**

**Parametric Modeling Part 4**
- Operators, Conditionals, Logic, & Lists, part II
- Weekly Computation Assignment

**Fabrication Assignment I Due**

**Reading**
- Branko Koloravic, “Digital Morphogenesis” in *Architecture in the Digital Age: Design and Manufacturing* (Course Reader)

WEEK 5

**Reading Group IV: Student presentation on prior week’s reading**

**Parametric Modeling Part 5**
- Surface Geometry Primer
- Box Geometry Primer
- Primitives, Boxes, and Surface Instantiation
- Weekly Computation Assignment

**Fabrication Assignment II** : CNC Mill Project

**Reading**
- Ferda Kolaton “Introduction” in *MEANDER: Variegating Architecture* (Course Reader)

WEEK 6

**Reading Group V: Student presentation on prior week’s reading**

**Parametric Modeling Part 6**
- Rhino CAM

**Reading**
- Jean Grenier, “Composites” and Jean-Baptiste Touchard “The Computer in the Service of the Designer” in *Industrial Design Techniques and Materials*

WEEK 7

**Introduction to CNC Mill Fabrication**

**Milled Material Examples**

**Material Presentation**
- Composites and Finite Element Analysis

**Desk Crits**

WEEK 8

**Parametric Modeling Part 7**
- Fabrication/Assembly
WEEK 9
Fabrication Assignment II Due: CNC Mill Project
Desk Crits
Parametric Modeling Part 8
   Advanced Surface Geometry Primer
   Advance Parametric Precedents
Fabrication Assignment III: Hybrid

WEEK 10
Parametric Modeling Part 9
   Advanced Curve Geometry Primer
Desk Crits

WEEK 11
Desk Crits

WEEK 12
Fabrication Assignment III: Hybrid -- Mid-Review

WEEKS 13 & 14
Desk Crits

WEEK 15
Fabrication Assignment III: Hybrid Due-- Final Review