FAB LAB PRIMER

Fabricating Digital Geometries

Greg Lynn, stereolithography model (*Embryological House)*

OVERVIEW

This course serves as an introduction to equipment available in the MAT/FAB Lab at the Knowlton School of Architecture with an emphasis on the two most widely used technologies: 3D printing and CNC machining.

The CNC machining section will address the entire workflow of a project from digital model and drawing through the running of a job. You will learn what tools to use when, how to properly prepare and hold down material stock, calculate spindle RPMs and feed rate of system, how to generate effective and efficient tool paths and how to operate the CNC interface.

The 3D printing section will briefly look at the basic principles of additive manufacturing and a range of existing technologies before focusing on the two systems used at the KSA: Fused Deposition Modeling (FDM) and binder jetting (3DP). We will address effective modeling practices, working with STL files and troubleshooting problem parts.

STRUCTURE

The topics will be presented through a series of lectures, demonstrations and workshops. Typically, lectures and software demonstrations will take place in the computer lab (Rm 430) and equipment demonstrations and workshops will happen in the MAT/FAB Lab.

DESIGN PROBLEM

Exercises surrounding a design problem will run parallel to the introduction of 3D printing and CNC machining with the option to use other equipment as time permits. These assignments are intended to give students first-hand experience in the entire workflow of a respective topic.

In 3D printing this will include model craft, exporting as well-formed STL file, processing STL file for use in multiple printers, extraction and post processing. For CNC machining this includes preparing both surface and curve geometries, setting up a CAM file and operating the CNC controller.

PARTICIPATION
Each student will be expected to attend and contribute in class. Participation includes things such as class attendance, in-class discussion, and in-class demonstrations and workshops.

Only excused absences are permitted from missing class. Written verification for excused absences is required. Excused absences are as follows:

- **Personal Illness:** Please notify the instructor within one week after the period of illness.
- **Serious illness or death of a member of the student's immediate family**: Please notify the instructor within one week after the funeral or period of illness.
- **Military or Government Duty:** Please notify the instructor prior to service.
- **Official University trips (sponsored by classes; intercollegiate athletics or other activites).** Notice must be given prior to the event.
- **Major Religious Holidays:** A student must notify the instructor in writing (email is fine) of these dates; please submit to the instructor no later than the last day for adding class.

ASSIGNMENT DEADLINES
Course assignments are due as noted in each assignment.
- Students who miss deadlines due to excused absences may submit the required work at a date agreed upon with the instructor.
- Unexcused late projects are not accepted, incomplete projects are evaluated in relation to their degree of completion, and a student is allowed to present only if he or she presents sufficient work to the instructor.
- Failure to turn in any assignment will result in a failing grade for the course

GENERAL COURSE REQUIREMENTS
- ☐ Keep electronic copies of all of your work. Final documentation will be turned in on paper and electronically.
- ☐ **Save back-ups of your work.** Computer crashes and technology failures are not accepted reasons for late or missing work.

ACADEMIC CONDUCT
All members of the class are expected to follow the rules of proper academic conduct as defined in section 3335-31-02 of the university's legal policies (see below). Academic misconduct includes, but is not limited to, giving or receiving information during an exam and submitting plagiarized work for academic requirements. Students are encouraged to discuss class concepts and coursework with one another as this furthers understanding and fosters critical thought. However, any work submitted for evaluation must be your own work. The instructor reserves the right to ask you to explain your approach to particular exercises or exam questions. You must be able to verbally demonstrate your understanding of the principles involved and failure to do so may affect your grade. Any work submitted for evaluation that includes work done by another, copying of another's work, or the result of following another's direct guidance is a case of academic misconduct. When academic misconduct is found in any assignment or examination you submit for evaluation it will be reported to the Director of the School and you will receive a zero grade.

Students with Disabilities: If a student requires accommodation for a disability, he or she should immediately arrange an appointment with the professors and the Office for Disability Services. At the appointment, the professors, disability counselors, and student can discuss the course format, anticipate needs and decide upon accommodations.

Sexual Harassment: O.S.U.'s Sexual Harassment policy, which applies to all faculty, staff, and students, includes lewd remarks and inappropriate comments made in the studio environment, classroom, and computer labs as well as the "display of inappropriate sexually oriented materials in a location where others can see it." Students can file a complaint by contacting Student Judicial Affairs at 292-0748. Sanctions include reprimand, suspension, and dismissal from the University.

SCHEDULE

Week 1: 3D Printing

5/6 - Tuesday	LECTURE (RM 430): **Introduction to additive manufacturing** DEMONSTRATION (MAT/FAB Lab): **The MAT/FAB Lab's 3D printers** *ASSIGNMENT 1*
5/8 - Thursday	DEMONSTRATION (RM 430): **Modeling Craft, STL files** & **processing software** WORKSHOP (MAT/FAB Lab): **Finishing 3D printed parts**

Week 2: CNC Routing

5/13 - Tuesday	*FOLLOW-UP ON ASSIGNMENT 1* DEMONSTRATION (RM 430): **RhinoCAM** *ASSIGNMENT 2*
5/15 - Thursday	WORKSHOP (MAT/FAB Lab): **Materials, stock preparation & tool selection** DEMONSTRATION (MAT/FAB Lab): **3-axis router**

Week 3: Secondary Processes

5/20 - Tuesday	DEMONSTRATION (MAT/FAB Lab): **5-axis router; CNC foam cutter** DEMONSTRATION (MAT/FAB Lab): **Vacuum Former**
5/22 - Thursday	DEMONSTRATION (MAT/FAB Fab Lab): **Fiberglass (Justin Diles) – DATE TBD** WORKSHOP (MAT/FAB Lab): **Casting Plaster**

Week 4: Production

5/27 - Tuesday	WORK SESSION (MAT/FAB Lab)
5/29 - Thursday	WORK SESSION (MAT/FAB Lab)

SUGGESTED READING

Beorkrem, Christopher. *Material Strategies in Digital Fabrication.* New York: Routledge, 2013. Print.

Dunn, Nick. "NURBS & Meshes." *Digital Fabrication in Architecture*. London: Laurence King, 2012. 40-45. Print.

Gibson, I., D. W. Rosen, and B. Stucker. *Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing*. New York: Springer, 2010. Print.*

Hopkinson, N., R.J.M Hague, and P.M Dickens. *Rapid Manufacturing: An Industrial Revolution for the Digital Age*. Chichester: John Wiley & Sons, 2006. Print.

Pettis, Bre, Anna Kaziunas. France, and Jay Shergill. *Getting Started with MakerBot*. Sebastopol, CA: O'Reilly, 2013. Print.

** eBook available via OSU Library website*