Part I - The Technology of Making

Wednesday January 17

Introduction and Conceptual Foundation
- architecture and technology
- Technology Transfer
  - Geddes, Mumford, Jordan - Technics
  - Eliel and Eero Saarinen
- Tools, Craft, and Industrial Modernism
  - Machine, Tool, and “Machine-Tool”
- Craft by Machine
  - Can craft be achieved through machine description as effectively, innovatively, and creatively as by hand?
  - Does today’s “Machine” reveal a new approach toward craft, using technology and a designer’s sensibility on Numeric Control?

Concepts in Numerical Control
- Geometry and vectors
- Parametric description
- Cartesian geometry, 2-, 3-, and 5- axis motion, degrees of freedom
- Tooling, Process, and Control
- Types of CNC

Readings:
- The Art and Craft of the Machine - Frank Lloyd Wright [toolkit]
- Constructing the Future – Nixon, Kaplicky (Future Systems) [toolkit]

Monday January 22

2-Axis CNC - the Laser Cutter – hands on lab introduction
Discussion of laser technology, materials, techniques, tolerances, diffusion, specificity, Software geometric control, software laser (color/line) control, maintenance, safety

Assignment: Project 1 - Explore 2-axis laser control.
Readings:
- ARO Shure Studio book, December 2001 [CNC lab]
- Universal Systems Laser Cutter manual (reference) [CNC lab]

Wednesday January 24

Numeric Machines / CNC in the manufacturing industries
- The first automated fabrication machine - 1725
- Henry Ford and the Model-T
- Modern Techniques - cutting, carving, turning, molds/casting, stretch-forming
- Rapid Prototyping technology - 3D printers, Stereo Lithography, FDM
- Industrial Design and Production Modeling
- Robotics in manufacturing and building construction
- CAD, CAM, CAE, CIM

Assignment: Research an article on any NC technique and something made with it. Bring it to the next class for discussion.

Monday January 29

Discussion: NC Technology; Articles presentation.
Wednesday January 31

Project 1 (Laser) due in class - presentations and discussion

Monday February 5

Rapid Prototyping, 3D Printing & Additive 3-D Modeling – hands-on introduction
Discussion of additive three-dimensional construction using 3-D printing / RP technology; FDM technology; Visual Model vs. Functional Prototype; Object Topology and STL processing; Settings and Software control; Model Detail control.

Assignment: Project 2 - Explore Additive 3D Modeling / 3D Printing
- Techniques in CNC articles collection (skim) [CNC lab]

Wednesday February 7

Lab: Hands-on work with the Dimension 3-D Printer and software.

Monday February 12

"Describe and Make" – Tour the Physics Technical Services Facility
- NC milling and lathing
- Direct description - onboard NC

Wednesday February 14

Project 2 (Additive 3D / Printing) due in class - presentations and discussion

Monday February 19

3-Axis CNC – the Mill and Router – hands-on introduction
Discussion of Machine-Tools. Tools and bits; Feeds and speeds; Axes and machine control; G & M codes; Post-processors; CNC programming; 2-axis/3-axis paradigms; speculation on 5- and 6- axis systems. Maintenance. Safety.

Assignment: Project 3 - Explore 3-Axis description
Readings: - The Machinery's Handbook (reference) [CNC lab]
- CNC Programming Handbook (reference) [CNC lab]

Wednesday February 21

CAD / CAM software – Introduction and Lab
- Solid and Surface Modeling, Features and Parametrics
- Creating and translating 3-dimensional object descriptions
- Modeling Process rather than Geometry

Monday February 26

Lab: Hands-on work with the Router and Mill. In-Lab Exercise.

Wednesday February 28

Lab: More work with CAM software and advanced 3D Translating and fabricating complex 3-D conditions.

March 3-11 – Spring Recess
Monday March 12

Tools, Materials, and NC Code - more details on CNC machining.

Wednesday March 14

Project 3 (3-axis description) due in class - presentations and discussion

Part II - The Art of Making

Monday March 19

Tools, Fabrication, and Design
- Tools and the Architect
- The English Arts & Crafts movement
- The Bauhaus, Industrialization, and early Modernism

Assignment: Project 4 – Describe and make a well-known design detail
Readings: - On the Origins of the Bauhaus, Bauhaus, Magdalena Droste [toolkit]
- Responses to Machines, Building Systems, Industrialization, and Architecture, J. Russel, ch.3, p 69-77 [toolkit]

Wednesday March 21

Form and Shape – Constructing Architectural Surface Topologies
- Architectures of Curves - Asymptote, office dA, UN Studio, ...
- Surface – Form and concept.
- Constructing Surface.
- 3-D scanning & digitizing technology.

- Computer Aided Manufacturing of Custom Landscape Elements - The William Smith Clark Memorial, Landscape Architecture, 3/94 [SB469.L3]
- The Computer School, Architecture, 9/00 p. 93-107 [NA1.A326]

Monday March 26

Complexity and Control - Frank Gehry's office
- Idea to reality - How Bilbao was built
- Data Processing Architectural Design: Jim Glymph lecture, Spring 2001
- Catia software system / Digital Project - Databases of description

Assignment: Semester Project – Design a prototype part, process, or system
Part 1 – Define your research

- Precisely Loose: On Disney Hall and the Technology of the Curtain, Paolo Tombesi, Ume, 2005, no. 19, pp. 12-17. [Toolkit]
Wednesday March 28

Constructing Process – SHoP Architects | Erik Demaine

Discussion:
- Art, Industrialization, and Computation
- Design Intelligence: The shop in SHoP Architects
- Computational Origami – the art and science of folding
- Design Economy.

Readings:
- Design Intelligence: Or Thinking After the End of Metaphysics, Michael Speaks, Architectural design, vol. 72, no. 5, pp. 4-6, Sept 2002 [Toolkit]

Monday April 2

Tour of Piedmont Metal Fabricators - Louisa, Va. (tentative date)
- Large-scale CNC laser, brake, and punch; Metalwork design and fabrication

Wednesday April 4

Project 4 (Design Detail) due – Presentations and Discussion
Students also present initial research ideas for semester project

Monday April 9

Systems, Kits of Parts, and Numeric Control
- The philosophy of LEGO™
- The American-System Ready Cut and General Panel Systems
- Le Corbusier and the Modulor
- Furniture systems and mass-produced housing
- Construction systems innovation – MasterFit, others.

Assignment: Semester Project Part 2 - Produce a Fabrication Prototype

Readings:
- Office Revolution - a new furniture system by Asymptote, Architecture, 7/01, p.94-101 [NA1.A326] [Toolkit]

Wednesday April 11

Mass Customization and Small Variations – Numeric Control enters Design
- Consumer products manufacturing
- Variable Form – ShoP Architects
- Gehry revisited - the “fish and snake” idea
- Gregg Lynn and the Blob - algorithmic and numeric descriptors
- Introduction to Parametric thinking

Readings:
- We are all prosumers now, Blueprint, 1/98, p. 26-7 [NA1.B37] [Toolkit]
- The Smart Hands of Helga Jongerius, Metropolis, 7/02, p. 109-13, 157-8 [N 6535 .N5 M47] [Toolkit]
- Building a Better Blob, Joseph Giovanni, Architecture, 9/00, p. 126-9
- Gregg Lynn Form, Architecture, 9/00, p.99 [NA1.A326]
Part III - Innovations / Inventions

Monday April 16

Advanced Parametrics and Generative Modeling Paradigms (lab)
- Computational (process) description
- Dynamic, Constraints-Driven (Dimension-Driven) description
- Bentley Generative Components™ architectural modeling software
- Parametric Modeling and Fabrication
- Value Engineering design (how technology helps manage cost)

Wednesday April 18

Field Trip – Tecktonics Design (or other) – tentative
- Date and location TBD depending on scheduling.

Monday April 23

Preliminary Review of Semester Prototypes
- Innovations on geometry and fabrication
- Algorithms, parametrics and generating form
- Material response and manipulation
- Process and system

Final Assignment: Fabricate your Final Result

Wednesday April 25

More Parametric Modeling and Fabrication
- Applications of parametric technology
- Case study examples
- Student problems application

Monday April 30

Wrap-up and Conclusions

Finals Week Thursday, May 3 - Friday, May 11:

Final Presentation / Review of Semester Projects
- Date and location TBD