Digital Modeling & Fabrication

ARCH 301 | FALL 2023 | NJIT
Tue 6:00 pm - 9:00 pm
Instructor: Vincent Marchetto, AIA, *Principal at MHS Architecture*

> *"Give ordinary people the right tools, and they will design and build the most extraordinary things."*
>
> -Neil Gershenfeld, MIT Professor

Course Description

Digital fabrication is an exciting and emerging field that will radically transform the future of architecture and construction. This course will give students practical skills that will allow them to create digital CAD (computer-aided design) data that can be input directly to CAM (computer-aided manufacturing) equipment. Students will get hands-on experience with 3D printers, CNC mills, and laser cutters at NJIT's Makerspace.

Students will explore ways to introduce creativity to the linear process of digital fabrication. The course will go through the entire creative process from an initial sketch to finished product. Finally, there will be an ongoing discussion about what it means for an architect to live in a world where the paradigm of mass production becomes mass customization.

Assignment Weights

Research Assignment	5%
3D Printing Assignment	15%
CNC Milling Assignment	15%
Laser Cutting Assignment	15%
Midterm Review	20%
Final Project	30%

Class Calendar

Jan. 16th	Class introduction, research assignment introduced. Take Make 101.
Jan. 23rd	Research assignment review, CNC milling workshop with Dan Hayden.
Jan. 30th	CNC milling desk crit.

Feb 6th	CNC Milling digital .STEP files due, laser cutting tutorial, laser cutting assignment introduced.
Feb 13th	Laser cutting project desk crit.
Feb 20th	Laser cutting digital .DWG files due, 3D printing with Rhino tutorial.
Feb 27th	Laser cut models due, 3D printing desk crit.
Mar. 5th	3D printing digital files due, arduino tutorial, final assignment introduced.
Mar. 12th	Spring Break
Mar. 19th	3D printed models due, final assignment discussion.
Mar. 26th	Desk Crit
Apr. 2nd	Desk Crit
Apr. 9th	Mid-Review
Apr. 16th	Desk Crit
Apr. 23rd	Desk Crit
Apr. 30th	Final Review

Statement on Academic Integrity

"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:http://www5.njit.edu/ policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing, or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"

Kepler/Canvas:
Kepler is now part of Canvas. Work will be automatically archived upon uploading in the Assignments page of Canvas. Students should upload in pdf format at the file size used for presentation. Please login at: canvas.njit.edu/ Additional Instructions will be forthcoming.

Recommended Reading

Alexander, Christopher. *Notes on the Synthesis of Form*. Cambridge, MA: Harvard University Press, 1964.

Ben Redwood, Filemon Schoffer, Brian Garret. *The 3D Printing Handbook: Technologies, Design, and Applications*. Amsterdam, NL: 3D Hubs, 2017.

Dunn, Nick. *Architectural Modelmaking: Second Edition*. London, UK: Laurence King Publishers Ltd, 2014.

Gramazio, Fabio. *The Robotic Touch: How Robots Change Architecture*. Zurich, CH: Park Books AG, 2014.

Mollie Claypool, Manuel Jimenez Garcia, Gilles Retsin, Vicente Soler. *Robotic Building: Architecture in the Age of Automation*. Munich, GER: Detail, 2019.

Ronald Rael, Virginia San Fratello. *Printing Architecture: Innovative Recipes for 3D Printing*. New York: Princeton Architectural Press, 2018.

Werner, Megan. *Model Making*. New York, NY: Princeton Architectural Press, 2011.

Vincent Marchetto's Published Work

De Boer, Hans. *Onder Weg.* BNA Onderzoek, 2014 – p.164-165

Maas, Winy, Ulf Hackman, and Adrien Ravon. The Why Factory: Barba, Life in the Fully Adaptable Environment. Nai010 Publishers, 2015. p. 190-195.

Link to Vincent's Master Thesis. Completed at TU Delft in 2015.
https://repository.tudelft.nl/islandora/object/uuid%3Ab6bced76-1265-42f6-85b7-46853f283cee?collection=education

Software Used in Class

3D Modeling	– Rhino 7 / Grasshopper
Laser Cutting	– AutoCAD
3D Printing / Slicing	– Cura
CNC Milling	– Fusion 360
Research	– Microsoft 365 Suite
Presentations	– Adobe Creative Suite

Recommended Lectures

Speaker: Pauline van Dongen – Fashion Designer

Title: Wearable Technology
Location: TU Maastricht
Link: https://www.youtube.com/watch?v=9uuhxGhD9bo&t=246s
Length: 10 min

Speaker: Neil Gershenfeld – MIT Professor
Title: Self-Replicating Robots and the Future of Fabrication
Location: Lex Fridman Podcast
Link: https://www.youtube.com/watch?v=YDjOS0VHEr4
Length: 2 hrs 6 min

Speaker: Greg Lynn - Architect
Title: The FORM Family
Location: Harvard GSD
Link: https://www.youtube.com/watch?v=IMVapPv19fY
Length: 1hr 42min

Speaker: Xavier De Kestelier - Architect
Title: Off-World Architecture
Location: AA School of Architecture
Link: https://www.youtube.com/watch?v=-kfGbOJ4ev8
Length: 1hr 20min

Speaker: Leonel Moura - Artist
Title: Non-Human Art
Location: Berkley Center for New Media
Link: https://www.youtube.com/watch?v=c5Mxk4BMifQ&t=1732s
Length: 1hr 28min

Speaker: Kas Oosterhuis – Architect, TU Delft Professor
Title: We are Changing Your View on What is Beautiful and What's Not
Location: TU Delft
Link: https://www.youtube.com/watch?v=8tvsQLeSK-U
Length: 18min

Speaker: Stephen Wolfram – Computer Scientist
Title: Cellular Automata and Rule 30
Location: Lex Fridman Podcast
Link: https://www.youtube.com/watch?v=VguG_y05Xe8
Length: 22 min

Free Online Tutorials

Grasshopper
Nick Senske – YouTube Channel
https://www.youtube.com/@nsenske/videos

Ultimaker Cura / 3D Printing
How to Use Ultimaker Cura 5: A Beginner's Guide 2023
https://www.youtube.com/watch?v=qHJSz4V7DJk

Python Coding
Harvard CS50's Introduction to Programming with Python
https://www.youtube.com/watch?v=nLRL_NcnK-4&list=PLEU-W3Mk-H3mTh0espH52bwN0a-RhghP6&index=4&t=560s

Modelmaking
Conceptual Model Build - Laser Cutting + CNC Routing
https://www.youtube.com/watch?v=F9Vcap96TZY