# **Digital Modeling & Fabrication**

ARCH 301 | SPRING 2025| NJIT Thurs 6:00 pm – 9:00 pm Instructor: Vincent Marchetto, AIA, *Principal at MHS Architecture* Contact: vpm23@njit.edu



\*Student Project Fall 2023, Eric Garzillo

# **Course Description**

Like architecture, digital fabrication sits at the intersection of art and science. It requires creative thinking to imagine complex geometry and an engineer's mind to bring the idea into reality. When creativity and engineering join forces, nothing is impossible.

This course will give students practical skills that will allow them to create digital CAD (computer-aided design) data in Rhino that can be fed directly to CAM (computer-aided manufacturing) equipment. The assignments will give students experience with 3D printers, CNC mills, and laser cutters at NJIT's Makerspace.

The first half of the course will consist of short assignments meant to introduce students to different digital fabrication techniques. The second half of the course will be a final assignment allowing students more time to develop a design before going forward with production. Students will make a mixed-medium model incorporating LED lighting. This introduces students to the complications of producing parts that connect and house electrical components.

# Assignment Weights

10%
10%
10%
10%
10%
20%
30%

# Class Calendar – Spring 2025

#### Week 1

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Date:	Topic:	Due:			
1/23/25	Introduction to Digital Fabrication Assignment: Rhino Surface Modeling	Nothing			
	Week 2				
Date:	Topic:	Due:			
1/30/25	Introduction to CNC Assignment: Rhino Model for CNC	Rhino Surface			
Week 3					
Date:	Topic:	Due:			
2/6/25	CNC Model Review Assignment: Export Model for CNC Milling	Rhino Model for CNC			
Week 4					
Date:	Topic:	Due:			
2/13/25	Introduction to Laser Cutting Assignment: Rhino Model for Laser Cutting	.STEP file for CNC Milling			
Week 5					
Dato:	Tonic	Duo			
2/20/25	Laser Cutting Model Review Assignment: Export Model for Laser Cutting	Rhino Model for Laser Cutting			
Week 6					
Date:	Topic:	Due:			
2/27/25	Introduction to 3D Printing Assignment: Rhino Model for 3D Printing	Rhino File for Laser Cutting			

Date:	Topic:		Due:		
3/6/25	3D Printing Model Review Assignment: Export Model for S	3D Printing	Rhino Model for 3D Printing		
		Week 8			
Date:	Topic:		Due:		
3/13/25	Final Assignment Introduced Assignment: Concept Sketch		.STL file for 3D Printing		
		Week 9			
Date:	Topic:		Due:		
3/27/25	Concept Sketch Review Assignment: Concept Rhino M	odel	Concept Sketch		
	N	Week 10			
Date:	Topic:		Due:		
4/3/25	Concept Model Review Assignment: Physical Prototyp	e	Concept Model		
	N	Week 11			
Date:	Topic:		Due:		
4/10/25	Mid-Project Review – 20 PTs Assignment: Update Prototype		Physical Prototype		
	١	Week 12			
Date:	Topic:		Due:		
4/17/25	LED Lighting with Arduino Assignment: Rhino Surface Mo	odeling	Updated Prototype		
	N	Week 13			
Date:	Topic:		Due:		
4/24/25	Desk Crit		Lighting Prototype		
	N	Week 14			
Date:	Topic:		Due:		
5/1/24	Final Desk Crit		Final Assignment		
Week 15					
Date:	Торіс:		Due:		
5/6/24	Final Assignment Review – 30	PTs	Final Assignment		

Week 7

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# 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"

# 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.

# Software Used in Class

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

# **Recommended Lectures**

Digital Modeling & Fabrication - Syllabus - Spring 2025

# Speaker: Pauline van Dongen – Fashion Designer

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

# Speaker: Neil Gershenfeld – MIT Professor

Title: Self-Replicating Robots and the Future of Fabrication Location: Lex Fridman Podcast Link: <u>https://www.youtube.com/watch?v=YDjOS0VHEr4</u> Length: 2 hrs 6 min

# Speaker: Greg Lynn - Architect

Title: The FORM Family Location: Harvard GSD Link: <u>https://www.youtube.com/watch?v=IMVapPv19fY</u> Length: 1hr 42min

# Speaker: Xavier De Kestelier - Architect

Title: Off-World Architecture Location: AA School of Architecture Link: <u>https://www.youtube.com/watch?v=-kfGbOJ4ev8</u> Length: 1hr 20min

# Speaker: Leonel Moura - Artist

Title: Non-Human Art Location: Berkley Center for New Media Link: <u>https://www.youtube.com/watch?v=c5Mxk4BMifQ&t=1732s</u> 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: <u>https://www.youtube.com/watch?v=8tvsQLeSK-U</u> Length: 18min

# Speaker: Stephen Wolfram – Computer Scientist

Title: Cellular Automata and Rule 30 Location: Lex Fridman Podcast Link: <u>https://www.youtube.com/watch?v=VguG\_y05Xe8</u> Length: 22 min

# Software Used in Class

3D Modeling – Rhino 7 / Grasshopper

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- Laser Cutting 3D Printing / Slicing CNC Milling Research Presentations
- AutoCAD
- Cura
- Fusion 360
- Microsoft 365 Suite
- Adobe Creative Suite

# 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 <u>https://www.youtube.com/watch?v=gHJSz4V7DJk</u>

# **Python Coding**

Harvard CS50's Introduction to Programming with Python <u>https://www.youtube.com/watch?v=nLRL\_NcnK-4&list=PLEU-W3Mk-</u> H3mTh0espH52bwN0a-RhghP6&index=4&t=560s

#### Modelmaking

Conceptual Model Build - Laser Cutting + CNC Routing <a href="https://www.youtube.com/watch?v=F9Vcap96TZY">https://www.youtube.com/watch?v=F9Vcap96TZY</a>

# 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. <u>https://repository.tudelft.nl/islandora/object/uuid%3Ab6bced76-1265-42f6-85b7-46853f283cee?collection=education</u>