FABRICATION TECHNOLOGIES

IE University
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Academic year: 22-23
Degree course: FOURTH
Semester: 2º
Category: COMPULSORY
Number of credits: 6.0
Language: English

PREREQUISITES

Students are expected to have:

- their own personal laptop with a classic 3 button mouse
- basic knowledge of Rhino and basic experience with rapid prototyping
- medium knowledge of Adobe editing pack (Illustrator, Photoshop, InDesign)
- medium knowledge of Miro

SUBJECT DESCRIPTION

This course introduces students to the fundamentals of digital fabrication and mass customization in a combined format of a seminar and a project-based pedagogy.

Mastering fabrication technologies is essential to approach design from a holistic, critical, and comprehensive perspective. Rather than being just about tools and techniques, fabrication is also about the alternative ecologies, politics, and economies it triggers, and digital-, distributed-, and/or personal-fabrication –the convergence between information technologies and fabrication techniques- has come to radically alter these relations. Strongly based on physical prototyping, this course aims to introduce students to both: the technical, as well as the relational aspects of this transformation.

This seminar is contextualized around the notions of circularity and open-making (two important vectors operating behind this shift), and it is articulated in two blocks (**01.** strategies and **02.** applications). First block (more seminar-oriented) deals with core design strategies linked to the different additive and subtractive fabrication techniques (mainly through laser-cutting, 3D-printing, and CNC-milling). While in the second block (more project-based) students will learn to apply these and other techniques to the development of a single product, strategy, or brand, exploring the iterative logics of rapid prototyping.

OBJECTIVES AND SKILLS

The objectives of this course are twofold:

To provide the student with fundamental knowledge of the main logics and emerging practices built around digital and analog fabrication processes (**A**); and to encourage them to develop their own critical stance and strategic thinking on the role of fabrication within the wider scope of contemporary challenges (**B**).

This course aims to do that through the development of the following set of skills:

- **A1.** Understanding the very different logics digital vs. analog processes of fabrication (mass production vs. mass customization)
- **A2**. Mastering the different strategies that rule and lay behind the different digital fabrication processes (cutting and patterning, printing and modeling, assembling and milling)
- **A3.** Developing familiarity with the technical intricacies behind each one of the main digital fabrication techniques (laser cutting, 3D-printing, CNC-milling, tool-path modeling)
- **A4**. Developing familiarity with materials and machines handling, mastering their limitations and potentialities.

- **A1: Showing holistic understanding on the logics behind digital fabrication and mass customization.**
- **B1**. Building critical stance on the relation between craft, mass production and personal fabrication.
- **B2**. Demonstrating holistic understanding on the broad material and socio-cultural implications behind each fabrication technique.
- **B3**. Developing critical stance and personal discourse on the notions of circularity and open making.
- **B4**. Demonstrating capacity to build design strategies around fabrication narratives.

METHODOLOGY

The course is organized following a scaffolded scheme of incremental complexity, and it is articulated around two different blocks (01. strategies and 02. applications): the first one being more seminar oriented (quick lessons and fast responses), while the second one being more project based (each student defending and developing their own idea).

Block 01. Strategies deals with the logics and techniques behind three main fabrication pairs of processes, and it is articulated around three quick rounds or seminars. Each seminar will conclude with a group fabrication exercise. These exercises will be graded and will amount for the 10% of the final grade each. These three rounds will be themed as follows:

- Round 01.1. Cutting and patterning (Laser cutting)
- Round 01.2. Printing and modeling (3D printing)
- Round 01.3. Assembling and milling (CNC routing)

In parallel with these assignments, each group will develop a *Deconstruct* analysis/critique of a given item/product. This analysis will follow a threefold structure (*display*, *take-make-dispose diagram*, *loops and holes*) and presented at the end of the Block 01. This presentation will be graded and will amount for the 10% of the final grade. It will act as a conceptual basis on which to start developing Block 02 projects.

Block 02. Prototypes aims at applying and interweaving these and other techniques in a single design project developed by groups and will be articulated in three different rounds. This project will be introduced first week, and its development will be tracked on a regular basis. Its development will be graded and will amount for 20% of the final grade. The project will be presented publicly to an external jury. This presentation will be graded amounting for the 30% of the final grade, and jurors will participate of the process of this grading. The three different project rounds will be themed as follows:

- Round 02.1. Concept development (Lo-fi prototyping)
- Round 02.2. Material tests and prototypes (Mid-fi prototyping)
- Round 02.3. Refinement and representation (Hi-fi prototyping)

Session modes
All 30 sessions will be presential on-site and will be articulated around the following types:

Theory (practical introduction to theme, logic, or technique; including discussions regarding scope, calendar and deliverables).
Practice (hands-on tutorial on certain techniques and workflows, digital or not, related to some specific fabrication technique).
Desk crit (one-to-one Q & A session to follow-up the process on a one-to-one basis).
Pin-up (group-by-group public presentation followed by a peer-to-peer discussion review).

First block will combine theory and practice, while second block will be more focused on desk crits and pin-up presentations.

Class participation will be graded and can modulate up to a 10% of the final evaluation.

Teaching methodology	Weighting	Estimated time a student should dedicate to prepare for and participate in
Lectures	13.33 %	20 hours
Discussions	16.67 %	25 hours
Exercises	20.0 %	30 hours
Group work	30.0 %	45 hours
Other individual studying	20.0 %	30 hours
TOTAL	100.0 %	150 hours

PROGRAM

SESSIONS 1 - 2 (LIVE IN-PERSON)

Introduction to the general scope, calendar, and methodology

Introduction to the Block 01. Strategies

[01.1.1. THEORY]

Theoretical framing (*on the expanded-context of fabrication technologies*).

Introduction to the shift from mass production to mass customization.

Introduction to the *Deconstruct* assignment in its different phases (display, take-make-dispose diagram, loops and holes).

Calendar, blocks, deliverables and grading.

SESSION 3 (LIVE IN-PERSON)

Cutting and patterning
[01.1.1. THEORY]

Theoretical framing (*from Albers to the Media Lab*)

Emerging practices

Tools and techniques

Scope and deliverables

SESSION 4 (LIVE IN-PERSON)

Cutting and patterning
[01.1.2. PRACTICE]

2D to 3D to 2D

Unrolling and nesting

Laser cutting tips and tricks

SESSION 5 (LIVE IN-PERSON)

Cutting and patterning
[01.1.3. DESK CRIT]

Q & A Session

SESSION 6 (LIVE IN-PERSON)

Cutting and patterning
[01.1.4. PIN-UP PRESENTATION]

Physical test and delivery of the *patterning* prototype.
It will be graded and amount for the 10% of the final grade.

Delivery of the first *Deconstruct* assignment (*Layout*).

SESSION 7 (LIVE IN-PERSON)

Printing and modeling
[01.2.1. THEORY]

Theoretical framing (*from Moholy-Nagy to Olivier van Herpt*)

Emerging practices

Tools and techniques

Scope and deliverables

SESSION 8 (LIVE IN-PERSON)

Printing and modeling
[01.2.2. PRACTICE]

3D to 2D to 3D

Nurbs and meshes

3D printing and slicers tips and tricks

SESSION 9 (LIVE IN-PERSON)

Printing and modeling
[01.2.3. DESK CRIT]

Q & A Session

SESSION 10 (LIVE IN-PERSON)

Printing and modeling
[01.2.4. PIN-UP PRESENTATION]

Physical test and delivery of the *printing* prototype.
It will be graded and amount for the 10% of the final grade.

Delivery of the second *Deconstruct* assignment (*Take-make-dispose diagram*).

SESSION 11 (LIVE IN-PERSON)

Assembling and milling
[01.3.1. THEORY]

Theoretical framing (*from Enzo Mari to the Bouroullecs*)

Emerging practices

Tools and techniques

Scope and deliverables

SESSION 12 (LIVE IN-PERSON)

Assembling and milling
[01.3.2. PRACTICE]

3D to 2D to 3D

Press-fit and 3D milling

CNC router tips and tricks

SESSION 13 (LIVE IN-PERSON)

Assembling and milling
[01.3.3. DESK CRIT]

Q & A Session

SESSION 14 (LIVE IN-PERSON)

Assembling and milling
[01.3.4. PIN-UP PRESENTATION]

Physical test and delivery of the *milling* prototype.
It will be graded and amount for the 10% of the final grade.

Delivery of the last *Deconstruct* assignment (*loops and holes*).
Group-by-group public presentation of *Deconstruct* with peer review discussion and reviews.
This research/presentation will be graded and amount for the 10% of the final grade.

SESSION 15 (LIVE IN-PERSON)

Introduction to the Block 02. Applications
[02. THEORY]

Theoretical framing (from sketching to rapid prototyping).

The notion of fidelity or resolution in prototyping.

Scope and deliverables.

SESSIONS 16 - 17 (LIVE IN-PERSON)

Rapid prototyping
[02.1.1 DESK CRITS]

One-to-one review of the *lo-fi prototypes*.

Concept building.

Q & A Session

SESSIONS 18 - 19 (LIVE IN-PERSON)

Deep prototypes and material testing
[02.1.2 DESK CRITS]

One-to-one review of the *mid-fi prototypes*.

Material tests and samples.

Q & A Session

SESSIONS 20 - 21 (LIVE IN-PERSON)

Broad-scope prototypes
[02.1.3 DESK CRITS]

One-to-one review of the *hi-fi prototypes*.

Concept refinement: circularity and open-making personal stance.

Q & A Session

SESSION 22 (LIVE IN-PERSON)

Circularity and open making
[02.1.4 PIN-UP PRESENTATION]

Group-by-group public presentation followed by a peer-to-peer review and discussion.
This presentation will be graded and will amount for the 20% of the final grade.

To be discussed:

- Fabrication and material strategies (possible further optimization and refinement).
- Circularity and open making narratives (take-make-dispose personal stance and story-telling).

SESSIONS 23 - 24 (LIVE IN-PERSON)

Robotic story-telling
[02.2.1 PRACTICE]

Digital fabrication and mixed-media applications.

Robotic arm programming and tool-path modeling.

Story-telling practical case.

SESSIONS 25 - 26 (LIVE IN-PERSON)

Final desk crits and/or rehearsal presentations
[02.2.2 DESK CRITS]

One-to-one review of the project narratives.

Q & A Session

SESSIONS 27 - 28 (LIVE IN-PERSON)

Final desk crits and/or rehearsal presentations
[02.2.3 DESK CRITS]

One-to-one review of the project narratives.

Q & A Session

SESSIONS 29 - 30 (LIVE IN-PERSON)

Final presentation
[03. PUBLIC PIN-UP PRESENTATION]

Public presentation with the participation of an external jury.

Final project group delivery (text descriptions, packaged images, PDF keynote, physical prototypes and fabrication files)

Final presentation will be graded and will amount for the 30% of the final grade. Jurors will participate from the grading process of this final presentation.

BIBLIOGRAPHY

Compulsory

- Leonard E. Read. *I, Pencil.* FEE Foundation for Economic Education. ISBN 1572460431 (Printed)
- Thomas Thwaites. *The Toaster Project, or the heroic attempt to build a simple electric appliance from scratch.* Princeton Architectural Press. ISBN 9781568989976 (Printed)
- Alice Rawsthorn. *Design as an Attitude.* JRP Ringier. ISBN 3037645210 (Printed)

Recommended

- Neil Gershenfeld. *FAB, The Coming Revolution on your desktop - from personal computers to personal fabrication.* Basic Books. ISBN 9780465027460 (Printed)

EVALUATION CRITERIA

Grades are composed out of four main parameters (class participation, individual assignments, final presentation, and continuous evaluation), defined as follows:

Group assignments

They refer to the first three quick assignments (patterning, printing, milling) as well as to the *Deconstruct* analysis (**Block 01**) and they account each one of them for the 10% of the final grade< making up a total of **40%** of the final grade. They are defined along the following lines:

Depth. It refers to the student's capability of defend an accurate and well-articulated design discourse.

Representation. It refers to the quality of the media used to convey the message: physical prototypes, booklets and public presentations, and digital files.

Consistency. It refers to the student's ability to follow up, class by class, the thematic framework, structure and calendar of each round.

Continuous evaluation

It refers to the evolution of the project assignment (**Block 02**). It makes up for the **20%** of the final grade and it is measured in six partial installments of 4% (three belonging to the project drafts submitted during the first block, and three more belonging to the first three working sessions of the second block). They will be measured according to the following lines:

Depth. It refers to the group capability of defend an accurate, well-articulated, multi-layered and situated design discourse.

Consistency. It refers to the group's ability to follow up, class by class, the thematic framework, structure, and calendar of each round.

Final presentation

It refers to the project final presentation and makes up for the **30%** of the final grade.

Depth. It refers to the group capability of defend an accurate, well-articulated, multi-layered and situated design discourse.

Representation. It refers to the quality of the media used to convey the message: physical prototypes, booklets and public presentations, and digital files.

Consistency. It refers to the group's ability to follow up, class by class, the thematic framework, structure, and calendar of each round. It refers as well to their demonstrated ability to work as a coherent whole.

Jury's comments will also weight final presentation's grade.

Class Participation

Class participation makes up for **10%** of the final grade, and it is defined along the following vectors:

Depth. It is the main dimension; a high-quality comment reveals great insight and consistency.

Articulation. Great insights need to be well articulated, clearly exposed and well-integrated in the pace of the class.

Proactiveness. It is all about the appropriate measure, timing and frequency necessary to keep a fluid class/group dynamic.

Criteria	**Percentage**	**Comments**
Group Assignment	10 %	Patterning
Group Assignment	10 %	Printing
Group Assignment	10 %	Milling
Group Assignment	10 %	Deconstruct
Continuous Evaluation	20 %	Continuous evaluation
Final Presentation	30 %	Final presentation
Class Participation	10 %	Class Participation

Final grade breakdown

Outstanding/Sobresaliente: 9.0-10.0 (A to A+)
Consistently produces work of the highest quality and craft; exhibits notable progress and development over the course of the semester; meets all course objectives at highest level; attendance is near-perfect, and contributions to course discussions are extremely valuable.

Notable: 7.0-8.9 (B to B+)
Completes all assignments with work of above-average quality and craft; exhibits significant progress and development; meets most course objectives; attendance and participation are very good.

Aprobado: 6.0-6.9 (C to C+)
Completes all assignments with work of acceptable quality and craft; exhibits some progress and development; meets a majority of course objectives. Attendance and participation are acceptable.

Aprobado: 5.0-5.9 (D)
Assignments are delivered but are incomplete and/or of low quality and craft; exhibits little progress and development; meets few course objectives. Attendance and participation are poor, but absences do not total more than 30%

Suspenso: 0-4.9 (F)
Work is incomplete, missing, or does not meet course objectives. Attendance and participation are poor.

Automatic Failure/Suspenso: 0 (F)
Please note that a student who misses 30% or more of the scheduled sessions receives an automatic 0.0, and loses his or her right to the second “convocatoria."

PROFESSOR BIO

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Rodrigo Rubio is an architect, designer and researcher working at the intersection between fabrication, ecology and computation. He holds a MArch with Honors from the UPM-ETSAM and a post-professional Master in Advanced Architecture from the UPC-IAAC.

In 2016 he co-founded the Madrid-based design collaborative practice 50(Super(Real)). His professional work has been recognized and awarded in national and international competitions such as the First Self-sufficient International Contest, the Arizona Challenge, the Torre Antena Santiago de Chile and the Portes de Collserola.

Since 2008 he has served more than ten years researching on digital fabrication, self-sufficiency and domesticity, teaching and lecturing at institutions such as IAAC and Elisava in Barcelona; UPM, Madid; UPV, Valencia; LNEC, Lisbon; KU, Kuwait; TSA, New Orleans; and he has been directing/codirecting research projects at IAAC such the Hyperhabitat (Venice Biennale 2008), the Fab Lab House (Solar Decathlon Europe, Madrid, 2010), the Fab Condenser (Fab 10 Digital Fabrication World Congress, Barcelona, 2014) and the BCN Circular Economy (Ajuntament de Barcelona, 2016). In 2019 he was awarded with a Design Teaching & Research Fellowship at the Tulane University in New Orleans. His research and academic work have been widely published in national and international platforms such as PLAT, REIA, Wired and Mark.

Rodrigo is currently Adjunct Professor of Fabrication Technologies at IE University (Madrid), PhD candidate at the Design Department of the UPM-ETSAM (Madrid) and Visiting Scholar at UC-Berkeley (California).

OTHER INFORMATION

Office Hours: Students should contact the professor to make an appointment.
Contact: rrubioc@faculty.ie.edu