UNIVERSITY of NICOSIA

Course Syllabus

Course Code	Course Title	ECTS Credits
ARCH-580DL	Robotic Fabrication	10
Prerequisites	**Department**	**Semester**
ARCH-570DL	Architecture	Spring
Type of Course	**Field**	**Language of Instruction**
Required	Design + Fabrication	English
Level of Course	**Lecturer(s)**	**Year of Study**
2nd Cycle	Pavlos Fereos / Eftihis Efthimiou	1st
Mode of Delivery	**Work Placement**	**Co-requisites**
Distance Learning	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- To speculate on the use of robotic arms into the rapid fabrication of architectural elements or discreet geometrical forms.
- To introduce students to a 6-axis robotic system and 3D-coordinates, moving beyond from traditional projective representation systems of architecture.
- To enable students to explore work on large-scale industrial-level fabrication.
- To allow students to develop an innovative problem-solving character to respond to hands-on problems and challenges that arise in robotic labs.
- To establish a connection between the digital design in architecture and robotic fabrication in other industries.
- To explore the use of robotic arms to accelerate time-consuming manual fabrication processes while maintaining the accuracy and precision of the result.
- To encourage students to explore material properties and limitations via robotic arms manipulation.
- To establish innovative feedback-loop processes for scientific assessment via a digital-to-fabrication research methodology.
- To identify and analyse reference published papers in the ‘robots in architecture’ research platform that will allow the emergence of a critical theoretical position.
- To explore case studies of existing robotic fabrication projects to test analytic capability and develop a vocabulary of robots in architecture.

Learning Outcomes:

After completion of the course students are expected to be able to:

1. Demonstrate knowledge of programming and controlling 6-axis robotic arms.
2. Display high-sense of control of three-dimensional space, Cartesian coordinate system and the concepts of Forward and Reverse Kinematics.
3. Have developed an appreciation and understanding of industrial robotic techniques as a mean to materialize design in architecture.
4. Acquire the skills to solve problems that emerge from material properties and their behaviour / limitations,
5. Acquire the ability to work in a lab as part of a large group and operate efficiently within a team.
6. Show evidence of developing a sense of coherency from theoretical questions raised to answering them through material and fabrication research in a lab.
7. Display a physical 'analytic capability' through the ability to understand published text / drawings / 3D Models of Robotic research in architecture.
8. Interpret how computational techniques in design, optimisation and construction are integrated in the generation and realisation of architectural projects.

Course Contents:

1. Existing Literature on Robotic Experimentation in Architecture.
2. 6-Axis Robotic Movement
3. Forward and Reverse Kinematics
4. Robotic fabrication process optimisation
5. Industrial applications of Robotic Arms
6. Custom or industrial robotic arm extensions: Grippers, Milling Drills, Hot-Wire Cutters, Extruders.
7. Material Properties and Material limitations
8. Rhinoceros3D, Grasshopper, HAL, TACO, Robot Studio

Learning Activities and Teaching Methods:

Introductory robot software workshops, presentations of existing literature, group project work, team assessment based on theoretical hypothesis and physical output, self-analysis, self-assessment, team support and feedback, tutorials.

Assessment Methods:

The lecture course is assessed by the submission of coursework (assignments):

- Presentations and short writings of a hypothesis for a proposed application in Architecture of an innovative Robotic Fabrication technique in relation to an explicit material of choice. Presentation of precedents and existing literature and the proposed technique's contribution.
- Robotic Fabrication Lab Team work. Programming and controlling Robotic Arms,

constructing custom extensions, achieving the hypothesis through fabrication, producing a constant feedback loop for optimisation, assessment and trial-and-error workflow.
- Final Exam. A thorough analysis of the fabrication process produced with a critical stance on the hypothesis, the results and problems that arose along with their resolution.

Required Textbooks / Reading:

Title	Author(s)	Publisher	Year	ISBN
Robotic Fabrication in Architecture, Art and Design 2016	Dagmar Reinhardt, Rob Saunders, Jane Burry	Springer International Publishing	2016	9783319263762 e-book: 9783319263786
The Robotic Touch: How Robots Change Architecture	Fabio Gramazio, Matthias Kohler, Jan Willmann	Park Books	2014	3906027376

Recommended Textbooks / Reading:

Title	Author(s)	Publisher	Year	ISBN
AD: Made by Robots: Challenging Architecture at a Larger Scale	Fabio Gramazio, Matthias Kohler	John Willey and Sons	2014	1118535480
Rob|Arch 2012: Robotic Fabrication in Architecture, Art and Design	Sigrid Brell-Cokcan, Johannes Braumann	Ambra	2013	3709114640
Robotic Fabrication in Architecture, Art and Design	Wes McGee, Monica Ponce de Leon, Sigrid Brell-Cokcan	Springer International Publishing	2014	3319046624