ARCHITECTURAL GEOMETRY 1

Bachelor in Architectural Studies BAS SEP-2023 AG1-AS.1.S.A

Area Architecture and Design

Number of sessions: 30

Academic year: 23-24

Degree course: FIRST

Number of credits: 6.0

Semester: 2º

Category: BASIC

Language: English

Professor: **ALESSANDRO MATTOCCIA**

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ALESSANDRO MATTOCCIA

Alessandro is a co-founder of 50SuperReal studio, where he focuses on applying coding to the automatisation of design and technical processes, as well as playing the role of computational expert.

He is currently an adjunct professor at IE School of Architecture and Design where he teaches Mathematics and Computational Geometry, Co-Director at Structuralia in the Master “BIM and Smart Buildings” as well as professor in the “Programming applied to BIM” Master programe.

Alessandro spends a lot of his time in educational processes, giving lectures, workshops and corporate training programs. Previously, he has been teaching in ETSAM as part of the Masters in Advanced Infographics, and you can find his online classes on several different educational and profesional platforms. He has also been a researcher in the Institute of Advanced Architecture of Catalonia, focusing on urban scale projects, and part of MargenLab team designing and building architectural prototypes based on energy modelling and sustainable strategies.

Currently he is focusing his career in pushing the boundaries of the Building Information Modelling methodology. Processes as advanced modelling, automatisation and data informed geometry are his main topics of research, mixing programming and drafting to explore the digital capabilities of architecture and design.

Alessandro graduated cum laude in 2015 from the Faculty of Engineer in Pisa with a master degree in “Building Engineering and Architecture”, presenting a project that studied the intersection between vernacular architecture and information technologies, which can be found in several publications. Trough exchange programs, he has also studied at the Technical University of Riga and the Institute of Advanced Architecture of Catalonia (IAAC). In 2016 he enrolled the International Master BIM Manager from Zigurat, Global Institute of Technology.

Office Hours

Office hours will be on request. Please contact at:

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SUBJECT DESCRIPTION

This course is structured as an introduction to shapes, methods, systems and rules to architectural form and its representation. The impact of the computer on architecture's perennial oscillation between the three and two dimensions of projection is reviewed.

Beginning from the fundamentals of orthographic projection, the course sequentially examines various types of forms, from simple to complex, in both two and three dimensions. Students will be required to constantly work between the construction of drawings, digital 3D models and physical models, gaining familiarity with the constraints and advantages of each.

Students will learn the geometrical conditions that define shapes, and the role that geometrical properties play in the definition of enclosure and structure, introducing basic tools and techniques in three-dimensional environments and places all these operations within the context of the role of drawing in the culture of architecture. The course will join analog and digital worlds, two and three dimensional environments, creating a seamless connection between these two realms.

LEARNING OBJECTIVES

The course tries to establish a stronger connection between descriptive geometry and knowledge of digital modelling to extend its practical applications. The primary objective of this class is to provide students with the tools to imagine and represent form, developing language that matches the richness and complexity of architecture. Each double session will be an exploration of different recipes, systems, techniques, that define shape and form, showing of real models of contemporary architecture. Through this process, students will be able to understand the logic behind a shape and to construct their own geometrical narrative.

During the course the students will be developing skills in representing spatially visualized objects through projections, physical modelling and 3D modelling, including wireframe, surface, subdivision and solid modeling. Students will acquire the skills to design and compellingly represent complex three-dimensional geometric constructs and apply them to formal building projects.

(according to Ministerial Decree EDU/2075/2010, 29 of July, and the official accreditation request for the Bachelor in Architectural Studies, July 2015; see BOCYL, 14 March p. 10477-10481.)

2.1 - BASIC AND GENERAL OBJECTIVES

CB1: Students have demonstrated knowledge and an understanding of a given area of study, building upon the foundation of secondary education, supported by advanced texts, and including aspects that engage the latest advances in their area of study.

CB2: Students know how to apply their knowledge professionally to their work or vocation and possess the competencies that are often demonstrated through elaboration and defense of arguments and the resolution of problems within their area of study.

CB3: Students can gather and interpret relevant facts (usually within their area of study) in order to make judgments that include reflection on relevant social, scientific, and ethical topics.

CB4: Students can transmit information, ideas, problems, and solutions to both specialized and non-specialized audiences.

CB5: Students have developed the necessary learning skills to continue their studies with a high degree of autonomy.

CG2: Knowledge of the role of the fine arts as a factor that can influence the quality of architectural creation.

CG7: An understanding of the relationship between people and buildings, and between buildings and their contexts, as well as the need to relate buildings and adjacent spaces to needs and to the human scale.

2.2 - SPECIFIC COMPETENCIES

CE1: Ability to apply graphic knowledge to the representation of spaces and objects.

CE3: Adequate knowledge of systems of spatial representation, as applied to architecture and urbanism.

CE4: Adequate knowledge of formal theory and analysis, and the laws of visual perception, as applied to architecture and urbanism.

CE5: Adequate knowledge of metric and projective geometry, as applied to architecture and urbanism.

CE6: Adequate knowledge of graphic surveying techniques in all phases, from sketching to scientific restitution, as applied to architecture and urbanism.

CE10: Adequate knowledge of the fundamentals of topography, hypsometry, cartography and site grading, as applied to architecture and urbanism.

2.3 - TRANSVERSE COMPETENCIES OF THE UNIVERSITY

T2: Ability to exercise professional behavior in accordance with constitutional principles and ethical values of the respective profession.

CT3: Manage unforeseen situations with the capacity to respond to changes within organizations. CT4: Use disciplinary knowledge to analyze and evaluate current situations.

CT5: Integrate oneself into interdisciplinary and multicultural teams to achieve common goals in a context of diversity.

CT6: Work actively in an international context.

TEACHING METHODOLOGY

IE University teaching method is defined by its collaborative, active, and applied nature. Students actively participate in the whole process to build their knowledge and sharpen their skills. Professor's main role is to lead and guide students to achieve the learning objectives of the course. This is done by engaging in a diverse range of teaching techniques and different types of learning activities such as the following:

Learning Activity	Weighting	Estimated time a student should dedicate to prepare for and participate in
Lectures	20.0 %	30.0 hours
Discussions	13.33 %	20.0 hours
Exercises in class, Asynchronous sessions, Field Work	20.0 %	30.0 hours
Individual studying	46.67 %	70.0 hours
TOTAL	100.0 %	150.0 hours

PROGRAM

SESSIONS 1 - 2 (LIVE IN-PERSON)

Introduction

Historical Overview. Method of Projections. Element of the Space.

Orthographic Projections

Point, Line and Plane.

SESSIONS 3 - 4 (LIVE IN-PERSON)

Auxiliary Views

Change of Projection Plane. The Rotational Method. Successive Auxiliary Views.

SESSIONS 5 - 6 (LIVE IN-PERSON)

Intersections 01

Intersection between two lines, two planes, line and plane.

SESSIONS 7 - 8 (LIVE IN-PERSON)

Solids

Prisms, Pyramids, Spheres and Cones.

Assignment 1 OUT

SESSIONS 9 - 10 (LIVE IN-PERSON)

Intersection 02

Intersection between solids.

SESSIONS 11 - 12 (LIVE IN-PERSON)

Geometrical Relations

True size. Parallel planes and lines. Perpendicular lines and planes.

SESSIONS 13 - 14 (LIVE IN-PERSON)

Mid Term Exam

Students will be asked to develop in class an exercise about Descriptive Geometry.

Two-Dimensional Transformations

Symmetry, Repetition, Gradation, Radiation.

Assignment 1 DUE (20% of the grade)

SESSIONS 15 - 16 (LIVE IN-PERSON)

Curves

Introduction to Curves. Editing and Manipulating Curves. Conic and Freeform Curves.

Assignment 2 OUT

SESSIONS 17 - 18 (LIVE IN-PERSON)

Digital Solids

Definition. Extrude Method. Boolean Operations and Solid Editing.

SESSIONS 19 - 20 (LIVE IN-PERSON)

Surface Classes

Translational, Ruled, Sweep and Revolution Surfaces. Quadric and FreeForm Surfaces.

SESSIONS 21 - 22 (LIVE IN-PERSON)

Three-Dimensional Transformations

Scaling, Twisting, Bending, Tapering, Mapping and Flowing.

Assignment 2 DUE (20% of the grade)

SESSIONS 23 - 24 (LIVE IN-PERSON)

Working with Surfaces and Curves

Trim, Split, Offset, Blend. Curve-Surface Interaction.

Assignment 3 OUT

SESSIONS 25 - 26 (LIVE IN-PERSON)

Mesh Geometry

Definition. Modeling techniques. SubDivision Modelling.

SESSIONS 27 - 28 (LIVE IN-PERSON)

Roof Geometry

Pitched Roofs, Vaults, Domes and Shells.

Topography

Topology, Contours and Profiles.

SESSIONS 29 - 30 (LIVE IN-PERSON)

Final Exam

Students will be asked to model the shape of a building showed to them (20% of the grade).

Assignment 3 DUE (20% of the grade)

EVALUATION CRITERIA

A. ASSIGNMENTS

The course relies on three assignments that require the student to work outside the class. The details of what these submissions imply will be discussed in detail in class and are mention above in the course program. The assignments are mandatory and makes up the 60% of the final grade.

B. MID-TERM

After introducing the main concepts of Descriptive Geometry, Students will be asked to develop an exercise in class which makes up 10% of the final grade.

C. FINAL EXAM

The last two sessions will be dedicated to the final exam which makes up 20% of the final grade. Students will be asked to model the shape of a building showed to them. The final exam will be based on everything studied from session 14 to 28 and Students are allowed to bring their own notes and support material, so they are encouraged to take notes throughout the course.

The final grade breakdown:

Sobresaliente/Outstanding: 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/Good: 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/Pass: 6.0-7.0 (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/Pass: 5.0-6.0 (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/Fail: 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 20% or more of the scheduled sessions receives an automatic 0.0, and loses his or her right to the second “convocatoria.”

criteria	percentage	Learning Objectives	Comments
Class Participation	10 %		
Assignments	60 %		

Mid-Term Exam	10 %		
Final Exam	20 %		

RE-SIT / RE-TAKE POLICY

BIBLIOGRAPHY

Recommended

- Helmutt Pottmann, Andreas Asperl, Michael Hofer, Axel Kilian. *Architectural Geometry.* ISBN 9781934493045 (Printed)
- Giancarlo Di Marco. *Simplified complexity. Method for advanced NURBS modeling with Rhinoceros.* ISBN 9788895315454 (Printed)
- A.T. Chahly. *Descriptive Geometry.* ISBN 9780714700717 (Printed)

BEHAVIOR RULES

Please, check the University's Code of Conduct here. The Program Director may provide further indications.

ATTENDANCE POLICY

Please, check the University's Attendance Policy here. The Program Director may provide further indications.

ETHICAL POLICY

Please, check the University's Ethics Code here. The Program Director may provide further indications.