CA5563: ADVANCED DIGITAL CONSTRUCTION

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Advanced Digital Construction

Subject Code
CA - Civil and Architectural Engineering
Course Number
5563

Academic Unit
Architecture and Civil Engineering (CA)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
The course provides knowledge on digital technologies in the construction industry. It encompasses advanced topics related to simulation, digitalization, and robotics. It brings the latest advancements in the construction industry to the students and

prepares their professionalism for their future career development. In this course, the instructor will: 1) introduce advanced digital design and construction techniques to the students, including computational and parametric design, artificial intelligence in design and construction, 3D printing and robotic arms, Arduino application in design and construction, and so on; 2) introduce state-of-the-art digital design and construction projects and research from universities around the world; 3) give tutorials to the students on commonly-used digital design and construction platforms and software, including Rhino, Grasshopper, Python, and their plug-ins; 4) supervise the students to take digital construction projects in groups as the assignment, in which each group will complete the design and construction of a 1:10-1:20 morphological model and a 1:1 joint model of a pavilion-scale construction.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Introduce the latest technological advancement in the construction industry			x	
2	Understand the major technological backgrounds of the relevant technologies		x		
3	Understand how the technologies can change the practice in the industry		x		
4	practice as a competent construction professional in implementing these technologies in real construction projects			x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Introduce the essential concepts of advanced digital technologies and development in the construction process	1, 2, 3, 4	2
2	Tutorial, site visit	Explore and discuss the current application of digital construction through hands-on exercises, case studies, or site visits.	1, 2, 3, 4	1

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Mid-term test	1, 2, 3, 4	10	-	No
2	Assignments	1, 2, 3, 4	80	-	Yes

Continuous Assessment (%)

90

Examination (%)

10

Examination Duration (Hours)

1.5

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

To pass a course, a student must obtain minimum marks of 30% in both coursework and examination components, and an overall mark of at least 40%.

Assessment Rubrics (AR)

Assessment Task

Mid-term Test (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to RECOGNIZE and EXPLAIN the key concepts, mechanisms, and technologies of the digital construction

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

1. CAPACITY to INQUIRE and ANALYSE the potential application of the digital technologies
2. ABILITY to ARTICULATE and EXPLAIN the rational, substantiated, and original discussion of advanced topics

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
ABILITY to EXPLAIN and DISCUSS the key concepts, mechanisms, framework, and concerns of the digital construction

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Mid-term Test (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
ABILITY to RECOGNIZE and EXPLAIN the key concepts, mechanisms, and technologies of the digital construction

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task
Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
1. CAPACITY to INQUIRE and ANALYSE the potential application of the digital technologies
2. ABILITY to ARTICULATE and EXPLAIN the rational, substantiated, and original discussion of advanced topics

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
ABILITY to EXPLAIN and DISCUSS the key concepts, mechanisms, framework, and concerns of the digital construction

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus
Construction simulation, virtual design, virtual environment, digital construction, digital design, robotics.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Snyder V. Refabricating Architecture: How Manufacturing Methodologies are Poised to Transform Building Construction[J]. 2005.
2	Caneparo L, Cerrato A. Digital fabrication in architecture, engineering and construction[M]. Springer Netherlands, 2014.
3	Williams K. Digital Fabrication[M]//Digital Fabrication. Birkhäuser, Basel, 2012: 407-408.
4	Iwamoto L. Digital fabrications: architectural and material techniques[M]. Princeton Architectural Press, 2013.
5	Frazer J. An evolutionary architecture[J]. 1995.
6	Dunn N. Digital fabrication in architecture[M]. Laurence King Publishing, 2012.
7	Mazzoleni I. Architecture follows nature-biomimetic principles for innovative design[M]. Crc Press, 2013.
8	Pohl G, Nachtigall W. Biomimetics for Architecture & Design: Nature-Analogies-Technology[M]. Springer, 2015.
9	Terzidis K. Algorithmic architecture[M]. Routledge, 2006.
10	Architectural Design 0403 emergences
11	Architectural Design 0602 Mophogenetic Design
12	Steenson M W. Architectural intelligence: How designers and architects created the digital landscape[M]. mit Press, 2022.
13	Leach N. Design in THE age of artificial intelligence[J]. Landscape Architecture Frontiers, 2018, 6(2): 8-20.
14	Picon A. Digital culture in architecture[M]//Digital Culture in Architecture. Birkhäuser, 2010.
15	Agkathidis A. Generative design[M]. Hachette UK, 2016.
16	Negroponte N. Soft architecture machines[M]. Cambridge, MA: MIT press, 1975.
17	Carpo M. The alphabet and the algorithm[M]. Mit Press, 2011.
18	Negroponte N. The architecture machine[J]. Computer-Aided Design, 1975, 7(3): 190-195.
19	The digital turn in architecture 1992-2012[M]. John Wiley & Sons, 2012.
20	Carpo M. The second digital turn: design beyond intelligence[M]. MIT press, 2017.