Unite! VECP on Architecture Engineering

is a Virtual Exchange Credit Program (VECP) in Unite! – the University Network for Innovation, Technology and Engineering. Students in Architecture and Civil engineering from Aalto-yliopisto and Technical University of Darmstadt and in *Ingegneria Edile* from Politecnico di Torino can select one or more online courses offered by the other universities and gain credits.

- **Level:** Master of Science
- **Period**: starting fall/winter 2021
- **Language of instruction:** English
- **Mode of Instruction:** Virtual

Topics: Architecture, Engineering, Digital Design and Construction, Sustainability, Advanced Manufacturing, Energy Efficiency, Parametric Design, Algorithmic Design, Structural Design
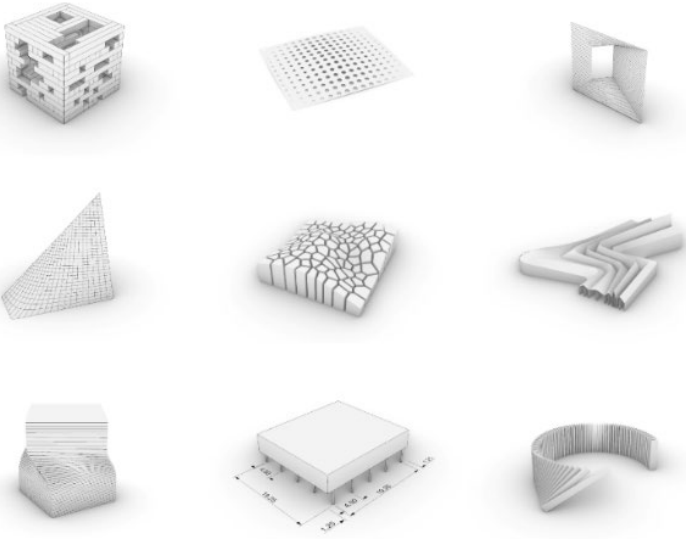
Summary of Courses offered

When reading the course information below, please pay attention to the different academic calendars, day and hour of the course and the course requirements. If you have questions on whether the course fits your study plan, please contact your professors or an academic advisor at your home institution.
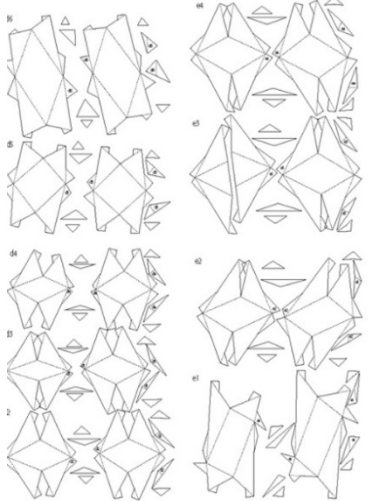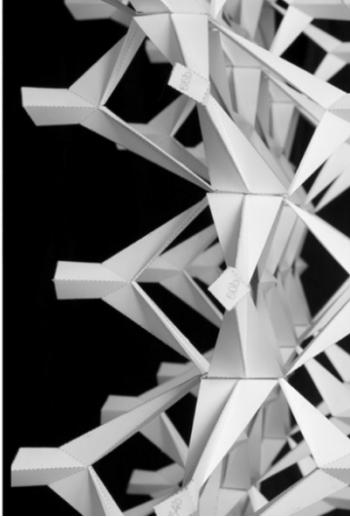
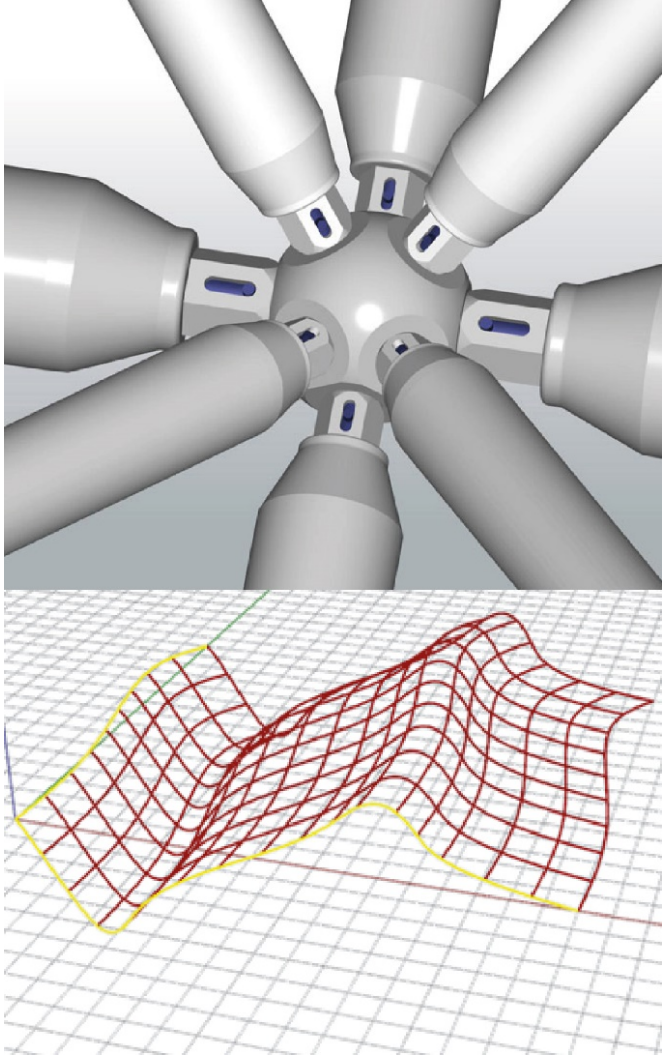| University	Lecturer	Course Name	Credits	Time Frame	Application Possible	Unite! Student Numbers
Technische Universität Darmstadt (Germany)	Oliver Tessmann (DDU)	Computational Design Basics	5	Summer (April to July) and Winter Semester (October to February)	Yes	7 from each partner 14 UNITE!
		Parametric Design and Construction	3/5*	Summer (April to July)	March 1	2 from each partner 4 UNITE!
	Ulrich Knaack (ISM+D)	Facade Technologies 1	6	Summer (April to July) and Winter Semester (October to February)	Yes	7 from each partner 14 UNITE!
	Jens Schneider	Spatial Structures	6	Summer (April to July)	March 1	5 from each partner 10 UNITE!

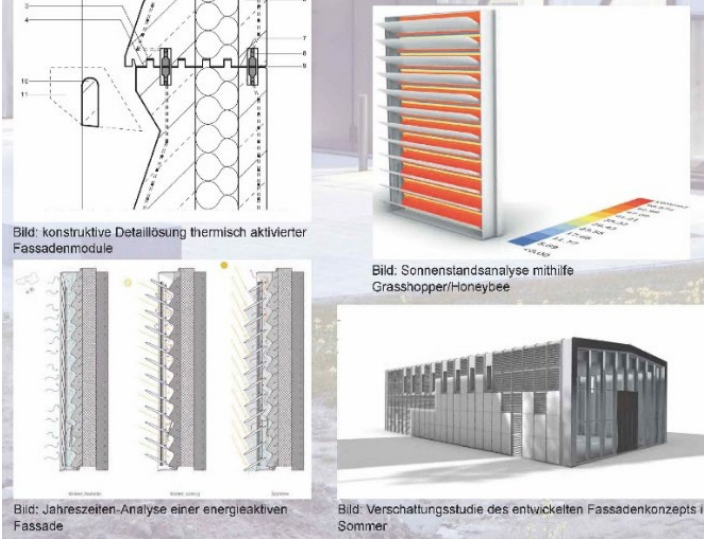| University	Lecturer	Course Name	Credits	Time Frame	Application Possible	Unite! Student Numbers
Aalto University (Finland)	Toni Kotnik	Parametric Design	3	January -February / Period 3 (6 weeks)	Yes	2 from each partner 4 UNITE!
	Toni Kotnik	Algorithmic Design	3/6*	March -May /Period 4 and 5 (12 weeks)	Yes	2 from each partner 4 UNITE!
*CP without/with Design Project						

Workload/ Prerequisites/ Course Literature: For the courses listed above please consult both the detailed course description and web link. Some courses have special prerequisites, please check the weblinks which provide information about literature required and further assessment guidelines and exams. Please contact the course professors if you require more information.
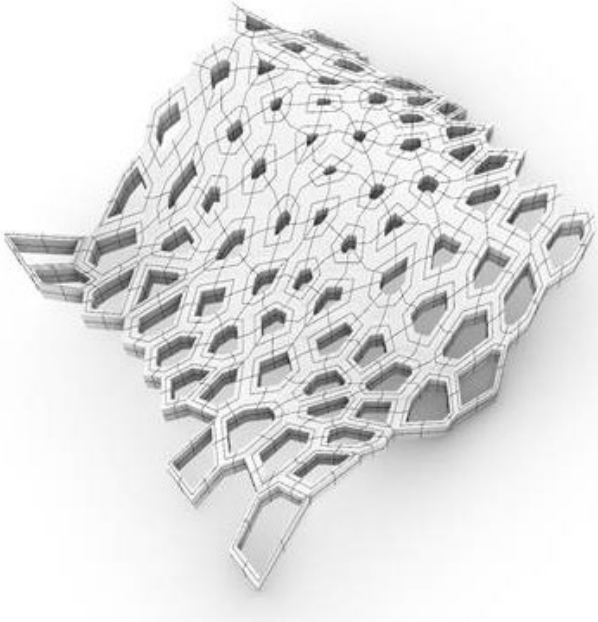
Detailed List of Courses offered from 2021/2022

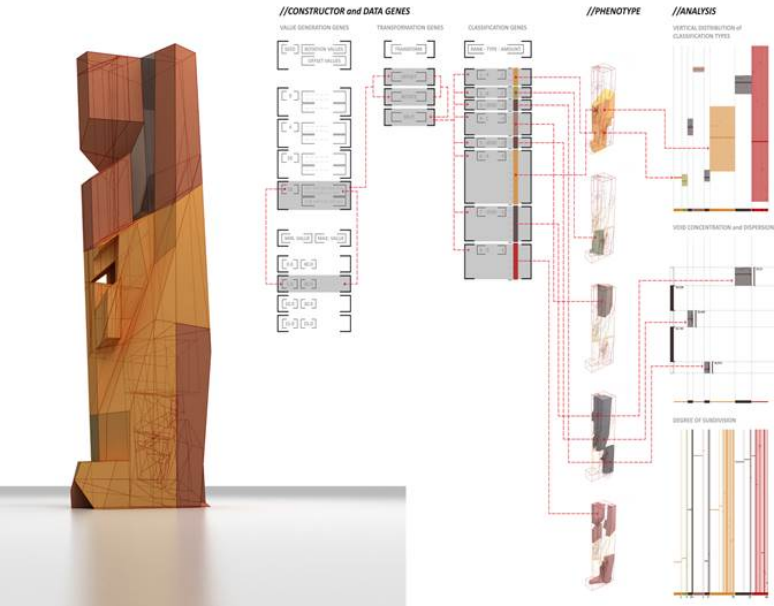| Module: Computational Design Basics	Module Number 15-02-6466/ 15-02-0422 (FM B)	Credits 3/5 CP	Effort 90/150 Hrs	Self Study 60/120 Hrs
The course introduces students to the tools and methods of computational design. Students will be introduced to 3d modeling techniques with Rhinoceros, parametric and algorithmic design with Grasshopper, and scripting with Python. The course is thought as an introduction to the different tools used in computational design, and it is beneficial particularly for students interested in continuing their research in the field of digital design and fabrication.				
Lecturer	Prof. Dr.- Ing. Oliver Tessmann			
Course dates (TBC)	Mid. October to Mid. February Winter/ Mid. April- Mid. July Summer semester			
Times (TBC)	Fri, 12.30 – 14.30			
Delivery Method	Moodle			
Assessment/Exam	After introduction to all the tools, students will be asked to develop a personal project, applying the learned tools in one of these four areas: digital fabrication, discrete modelling, generative design, environmental modelling, followed by an exam.			
Language	English			
Contact and Weblink	tessmann@dg.tu-darmstadt.de			
https://www.architektur.tu-darmstadt.de/media/architektur/2019_studieren/downloads_5/fb_15_allgemein/semesterbooklet/vergangenes_semester/Semesterbooklet_WS19-20.pdf Modulhandbuch B.Sc. Architektur: **15-02-0422** Page 14 / repeatability unlimited (Studienleistung) **15-02-6466** Page 34 / repeatability unlimited (Studienleistung) https://www.architektur.tu-darmstadt.de/media/architektur/2019_studieren/downloads_5/msc_architektur/studienordnung_2014/FB_15_3_MSc_Architektur_Modulhandbuch.pdf				

Module:	Module Number	Credits	Effort	Self Study
Parametric Design and Construction	15-02-6465/ 15-02-0422	3/5 CP	90/150 Hrs	60/120 Hrs

The Parametric Design and Construction course consists of a series of lecture, tutorials and design exercises. Parametric Design unlocks novel design possibilities and enables interdisciplinary collaboration of architects and structural engineers. These tools and methods will be applied and explored for the design of lightweight spatial structures. In this course participants will learn about space frame structures and their properties through examples from practice and a series of small design exercises. 3D modelling, parametric and structural design calculations will be conducted in Rhino, Grasshopper and Karamba. The course is linked to the Spatial Structures in the TU Da Engineering department. Architects and engineers will collaborate in interdisciplinary design teams.	

Lecturer	Prof. Dr.- Ing. Oliver Tessmann
Course dates (TBC)	30th April to 10th July **Summer semester only**
Times (TBC)	Monday, 14.30 – 18.00
Delivery Method	TU ID access to Moodle content/ TUCaN or direct email
Assessment/Exam	The exam consists of one colloquium and three small design exercises.
Language	English
Contact and Weblink	tessmann@dg.tu-darmstadt.de

https://www.architektur.tu-darmstadt.de/media/architektur/2019_studieren/downloads_5/fb_15_allgemein/semesterbooklet/Semesterbooklet_SoSe_2021.pdf
Modulhandbuch M.Sc. Architektur: **15-02-0422** Page 14 / repeatability unlimited (Studienleistung)
15-02-6465 Page 34 / repeatability unlimited (Studienleistung)
https://www.architektur.tu-darmstadt.de/media/architektur/2019_studieren/downloads_5/msc_architektur/studienordnung_2014/FB_15_3_MSc_Architektur_Modulhandbuch.pdf

Module: Spatial Structures	Module Number 13-M2-M010	Credits 6 CP	Effort 180 Hrs	Self Study 120 Hrs

The Spatial Structures course consists of a series of lecture, tutorials and design exercises that revolve around the design, analysis and fabrication of spatial structures. Lightweight spatial, vector-active structure allow for large spanning constructions. Parametric design and digital fabrication allow for ever more complex geometries. The lecture address basic characteristics of spatial structures and presents contemporary and historical examples from practice. The course is held as an interdisciplinary event in cooperation with the department Digital Design Unit (DDU) of the Department of Architecture. In this course participants will learn about space frame structures and their properties through examples from practice and a series of small design exercises. 3D modelling, parametric and structural design calculations will be conducted in Rhino, Grasshopper and Karamba. **Recommended:** Statics II (13-M2-M002), Steel Construction I (13-I1-M007)	
Lecturer	Prof. Dr.-Ing. Jens Schneider
Course dates (TBC)	30th April to 10th July **Summer semester only**
Times (TBC)	Monday, 14.30 – 18.00
Delivery Method	Moodle content/ TUCaN or direct email
Assessment/Exam	Subject examination: Oral examination (30 min., 3 attempts); Study achievement: 3 homework Assignments (total 90 hours, unlimited number of attempts)
Language	English
Contact and Weblink	schneider@ismd.tu-darmstadt.de
Räumliche Stabwerke – Institut für Statik und Konstruktion – TU Darmstadt (tu-darmstadt.de)	
Modulhandbuch M.Sc. Bauingenieurwesen – Civil Engineering (2021): TUCaN_MHB_M.Sc._BI-CE_2021_2021-05-07.pdf (tu-darmstadt.de)	

Module:	Module Number	Credits	Effort	Self Study
Façade Technologies 1	13-M4-M002	6 CP	180 Hrs	120Hrs

<table>
<tr><td>In view of the national and international climate targets, energy-efficient and energy-flexible facades play an increasingly important role. One current topic is "energy-active facades", which maximise the use of regenerative environmental heat for room air conditioning, while minimising the use of fossil fuels and complex heating and cooling technology. In addition to the lecture, a workshop will be held in which the students will develop a facade mockup which provides for thermal activation on both the outside and inside of the facade in order to absorb heat energy, store it temporarily and release it again at a suitable time. The design, construction and energy performance of the facade system are evaluated. As a tool for the design of the energy-active, inhomogeneous component in COVID-19 teaching, the participants use CAD program and a multiphysics tool for the analysis of heat storage capacity and transfer.</td><td>

Bild: konstruktive Detaillösung thermisch aktivierter Fassadenmodule

Bild: Sonnenstandsanalyse mithilfe Grasshopper/Honeybee

Bild: Jahreszeiten-Analyse einer energieaktiven Fassade

Bild: Verschattungsstudie des entwickelten Fassadenkonzepts i Sommer
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Lecturer	Prof. Dr.-Ing. Ulrich Knaack
Course dates (TBC)	1st October to 18th February Winter/ 30th April to 10th July Summer semester
Times (TBC)	Wed. 13:30 – 15:00
Delivery Method	Zoom and Direct Email
Assessment/Exam	Subject examination: Oral examination (15 min., 3 attempts); Study achievement: Term paper (unlimited number of attempts)
Language	English
Contact and Weblink	knaack@ismd.tu-darmstadt.de
Fassadentechnik I – Institut für Statik und Konstruktion – TU Darmstadt (tu-darmstadt.de)	
Modulhandbuch M.Sc. Bauingenieurwesen – Civil Engineering (2021): TUCaN_MHB_M.Sc._BI-CE_2021_2021-05-07.pdf (tu-darmstadt.de)	

Module:	Module Number	Credits	Effort	Self Study
Parametric Design	ARK-E2515	3CP	81 Hrs	45 Hrs

The course is an introduction into fundamental concepts of parametric design thinking in architecture and landscape architecture using Grasshopper (Rhinoceros plug- in). The course covers basics of geometry of curves and surfaces, NURBS- geometry and mesh geometry as well as data handling. It is taught as intense one-week long workshop at the beginning of the summer teaching period. Basic knowledge of parametric design thinking, the transformation of concepts into geometric operations and the implementation of these operations in a graphic scripting editor. **Requires:** Knowledge of Rhinoceros (basic knowledge NURBS curves surfaces).	
Lecturer	Prof Dr Toni Kotnik
Course dates (TBC)	January -February / Period 3 (6 weeks)
Times (TBC)	Tuesday 09.15-12.00
Delivery Method	Moodle
Assessment/Exam	Assessment is based on the evaluation of the exercises and the final design exercise. Participants need to submit successfully two Homework Exercises provided during the course and apply the skills to a small design exercise at the end of the course. 15 h of input lecture 20 h of exercise work. Re-submission of Exercises possible in consultation with teacher.
Language	English
Contact and Weblink	toni.kotnik@aalto.fi
https://oodi.aalto.fi/a/opintjakstied.jsp?html=1&kieli=6&Tunniste=ARK-E2515&Ajankohta=12-01-2021	

Module:	Module Number	Credits	Effort	Self Study
Algorithmic Design	ARK-E2515	6 CP	160 Hrs	90 Hrs

The course deals with methods of algorithmic design applied to the field of architecture, landscape and interior architecture, construction, as well as in the broad fields of industrial and product design. Although many architects still use computers much like they used analogue drawing boards, intrinsic capabilities of computers allow them to formalize their designs through code. This approach also captures and exploits the inherent contemporary condition of creative practices - when designs become data, it becomes possible to create what was previously undrawable. **Requires:** Basic knowledge of algorithmic design with ability to write and execute own Python scripts as well as formulate design problems in code.	

Lecturer	Prof Dr Toni Kotnik
Course dates (TBC)	March -May /Period 4 and 5 (12 weeks) Spring
Times (TBC)	Tuesday 09.15-12.00
Delivery Method	Moodle
Assessment/Exam	Students will be evaluated based on the project submitted at the end of the course. The submitted project needs to follow the guidelines which will be clearly communicated in the task description together with reference examples at the beginning of the course. 30 h of input lecture, 40 h of exercise work. Re-submission of Exercises possible in consultation with teacher.
Language	English
Contact and Weblink	toni.kotnik@aalto.fi
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