


Module manual Elective modules SS 26

Sustainable Civil Engineering

Bachelor full time

Study and examination regulations: SPO 2023

As of February 2026



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1 Overview

The WPF module handbook describes the individual compulsory elective modules (WPF) of the Sustainable Civil Engineering degree program.

In the Sustainable Civil Engineering degree program, elective modules (WPF) with a scope of at least 8 ECTS must be completed. WPF contribute to the achievement of the required 210 ECTS and are counted as compulsory modules. The WPF are scheduled for the 6th and 7th semesters, but it is possible to take the WPF as early as the 3rd semester.

The following modules can be selected to achieve the 8 ECTS credits.

Note: The WPF offer changes every semester. Please always refer to the latest WPF module handbook for the current range of modules.

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2 Subject specific compulsory elective modules (WPF)

3 Description of Modules

3.1 Electives

Building Energy Technology and Smart Homes			
Module abbreviation:	BETSH_ESYS	Reg.no.:	35
Curriculum:	Programme	Module type	Semester
	Sustainable Civil Engineering (SPO WS 23/24)	Einsetzungstext ist leer!	4
Responsible for module:	Akbar, Shariq		
Lecturer:	Akbar, Shariq; Reum, Tobias		
Language of instruction:	English	Language of exam:	English
Credit points / SWS:	4 ECTS / 4 SWS		
Workload:	Contact hours:		47 h
	Self-study:		54 h
	Total:		101 h
Subjects of the module:	Building Energy Technology and Smart Homes		
Lecture types:	SU/Ü/PR - seminar based teaching/Exercise course/laboratory		
Availability of the module:	None		
Examinations:			
LN - written exam, 90 minutes			
Additional Explanation:			
None			
Prerequisites according examination regulation:			
None			
Recommended prerequisites:			
None			
Objectives:			
<p>The students</p> <ul style="list-style-type: none"> • know different building envelope constructions and can calculate their thermal qualities. • know the energy balance of a building and understand the underlying building physics principles. • know the of relevance and influences of thermal comfort. • know about supply and distribution of thermal energy in buildings. • know the available systems and components for thermal energy supply by fossil and renewable sources. • know about thermal energy storage in buildings. • know about principles, constraints and planning of heat pumps. • know devices for heat transfer in buildings and can dimension them. • know the basics of ventilation systems. • know energy standards in new and existing buildings. • know how to calculate the size of a thermal energy supply system. • can compare Smart Homes to traditional control concepts. 			

Content:

Constraints about buildings

- overview of building types and energy consumption in buildings
- heat consumption for warm water and heating
- thermal comfort: influences from inside and outside, calculation mechanism
- Overview of building energy law and building energy certificates
- basic about ventilation systems
- heat supply systems and their dimensioning
- plant- and system technique natural gas and oil boilers
- plant- and system technique gas and el. heat pumps
- plant- and system technique wood pellet boilers
- plant- and system technique wood chip boilers
- system technique district heating systems
- Radiators
- floor heating systems
- Basic HVAC Design
- Smart Home /building information systems
- Actors und sensors in buildings

Literature:

- HENS, Hugo, 2024. *Building physics - heat, air and moisture: fundamentals, engineering methods, material properties and exercises*. Berlin, Germany: Ernst & Sohn. ISBN 978-3-433-03422-4, 3-433-03422-2
- AGARWAL, Parul, MITTAL, Mamta, AHMED, Jawed, IDREES, Sheikh Mohammad, 2022. *Smart Technologies for Energy and Environmental Sustainability* [online]. Cham: Springer International Publishing PDF e-Book. ISBN 978-3-030-80702-3. Available via: <https://doi.org/10.1007/978-3-030-80702-3>.
- KHAZALI, Javad, 2014. *Energy-efficient HVAC design: an essential guide for sustainable building* [online]. Cham: Springer International Publishing PDF e-Book. ISBN 978-3-319-11047-9, 978-3-319-11046-2. Available via: <https://doi.org/10.1007/978-3-319-11047-9>.
- JAIN, Arpit, SHARMA, Abhinav, JATELY, Vibhu, AZZOPARDI, Brian, 2024. *Sustainable energy solutions with artificial intelligence, blockchain technology, and internet of things* [online]. Boca Raton: CRC Press PDF e-Book. ISBN 978-1-003-35663-9. Available via: <https://doi.org/10.1201/9781003356639>.
- MORENO-MUÑOZ, Antonio and Neomar GIACOMINI, 2023. *Energy smart appliances: applications, methodologies, and challenges*. Piscataway, NJ: IEEE Press. ISBN 978-1-119-89945-7, 9781119899440

Additional remarks:

The module is not selectable if Gebäudeenergiechnik und Smart Homes is/was completed.

Energy Storage			
Module abbreviation:	EnergStor_ESYS	Reg.no.:	35
Curriculum:	Programme	Module type	Semester
	Sustainable Civil Engineering (SPO WS 23/24)	Einsetzungstext ist leer!	2
Responsible for module:	Reum, Tobias		
Lecturer:	Reum, Tobias; Schmitt, David		
Language of instruction:	English	Language of exam:	English
Credit points / SWS:	4 ECTS / 4 SWS		
Workload:	Contact hours:		47 h
	Self-study:		54 h
	Total:		101 h
Subjects of the module:	Energy Storage		
Lecture types:	SU/Ü/PR - seminar based teaching/Exercise course/laboratory		
Availability of the module:	None		
Examinations:			
LN - written exam, 90 minutes			
Additional Explanation:			
None			
Prerequisites according examination regulation:			
None			
Recommended prerequisites:			
None			
Objectives:			
The students			
<ul style="list-style-type: none"> • can judge the need of storage according to the energy economic situation. • can differentiate between base load and peak load storage. • can evaluate different storages technologies according to a variety of criteria. • can estimate the economic benefit of a storage system. • can dimensionate storage systems. 			
Content:			
<ul style="list-style-type: none"> • storage properties • energy density • storage cycles • charging speed • thermal energy storage • hot tap water storages • heating storage 			

- steam storage
- latent heat storage
- chemical storage
- dimensioning of storages
- electrical energy storages:
- battery basics
- charge control
- central vs decentral
- chemical storages
- gas storage hydrogen storage conversion efficiencies
- types of hydrogen storages
- mechanical storages
- pumped hydro
- compressed air storage

Literature:

- MATHEW, V. K., HOTTA, Tapano Kumar, ALI, Hafiz Muhammad, SUNDARAM, Senthilarasu, 2023. *Energy Storage Systems: Optimization and Applications* [online]. Singapore: Springer Nature Singapore PDF e-Book. ISBN 978-981-1945-02-1. Available via: <https://doi.org/10.1007/978-981-19-4502-1>.
- GUDE, Veera Ganeswar, 2023. *Energy storage for multigeneration: desalination, power, cooling and heating applications*. London: Elsevier. ISBN 978-0-12-821921-8
- NAMRATA, Kumari, SAINI, R. P., KOTHARI, D. P., 2024. *Wind and Solar Energy Systems* [online]. Singapore: Springer Nature Singapore PDF e-Book. ISBN 978-981-9997-10-7. Available via: <https://doi.org/10.1007/978-981-99-9710-7>.
- BRUN, Klaus, Timothy ALLISON and Richard DENNIS, 2021. *Thermal, mechanical, and hybrid chemical energy storage systems*. London, United Kingdom: Academic Press, an imprint of Elsevier. ISBN 978-0-12-819892-6

Additional remarks:

Not selectable if Energiespeicher is/was completed.

Plastisphere: Rethinking Plastics for a more Sustainable Built Environ			
Module abbreviation:	SCE_Plastisphere_FW	Reg.no.:	35
Curriculum:	Programme	Module type	Semester
	Sustainable Civil Engineering (SPO WS 23/24)	Specialised Elec- tive Subject	
Responsible for module:	Liepert, Tobias		
Lecturer:	Pichlmeier, Franziska		
Language of instruction:	English	Language of exam:	English
Credit points / SWS:	4 ECTS / 4 SWS		
Workload:	Contact hours:		46 h
	Self-study:		54 h
	Total:		100 h
Subjects of the module:	Plastisphere: Rethinking Plastics for a more Sustainable Built Environ		
Lecture types:	SU/Ü/PR - seminar based teaching/Exercise course/laboratory		
Availability of the module:	None		
Examinations:			
LN - seminar paper (8-15 pages) and oral presentation (15-20 minutes)			
Additional Explanation:			
Project work (group assignment), assessed through a presentation and discussion – 80%			
Individual written reflection – 20%			
Prerequisites according examination regulation:			
None			
Recommended prerequisites:			
None			
Objectives:			
After completing the module, students are able to ...			
<ul style="list-style-type: none"> analyze plastic-containing building products with regard to material composition, environmental impacts, and indoor environmental quality. apply life-cycle design approaches (including life cycle assessment and end-of-life considerations) to selected building components. identify limitations and trade-offs between technical performance, circular economy principles, environmental protection, and health aspects. develop well-founded strategies for the reduction, substitution, or deliberate use of plastics. present results in a clear and structured manner. collaborate constructively in groups and provide professional feedback. 			
Content:			
<ul style="list-style-type: none"> Plastics in the built environment: properties and fields of application Types of plastics and additives used in construction Indoor environmental quality, emissions, and indoor air quality 			

- Environmental impacts of plastics
- Fundamentals of life cycle assessment of building products
- Circular economy, recycling, and end-of-life scenarios
- Separability and deconstruction
- Project work: analysis and redesign of a building component or system
- Critical discussion of opportunities, risks, and trade-offs

Literature:

- PRASITTISOPIN, Lapyote, FERDOUS, Wahid, KAMCHOOM, Viroon, 2023. Microplastics in construction and built environment. In: *Developments in the built environment, 2023-10, Vol.15, p.100188, Article 100188*. ISSN 2666-1659
- Without author. *Reducing Plastics in Construction* [online]. [Accessed on:]. Available via: <https://asbp.org.uk/group/plastics-in-construction>
- Without author. *A Circular Economy Action Plan* [online]. [Accessed on:]. Available via: https://environment.ec.europa.eu/topics/circular-economy-topics/first-circular-economy-action-plan_en

Additional remarks:

None

Smart Grids and Wind Energy			
Module abbreviation:	SmGrWiEnerg_ESYS	Reg.no.:	35
Curriculum:	Programme	Module type	Semester
	Sustainable Civil Engineering (SPO WS 23/24)	Einsetzungstext ist leer!	6
Responsible for module:	Navarro Gevers, Daniel		
Lecturer:	Navarro Gevers, Daniel; Scherer Farina, Anneliese		
Language of instruction:	English	Language of exam:	English
Credit points / SWS:	4 ECTS / 4 SWS		
Workload:	Contact hours:		47 h
	Self-study:		54 h
	Total:		101 h
Subjects of the module:	Smart Grids and Wind Energy		
Lecture types:	SU/Ü/PR - seminar based teaching/Exercise course/laboratory		
Availability of the module:	None		
Examinations:			
LN - written exam, 90 minutes			
Additional Explanation:			
None			
Prerequisites according examination regulation:			
None			
Recommended prerequisites:			
None			
Objectives:			
The students			
<ul style="list-style-type: none"> • know the function of the most important network operating resources in the power grid. The functionality and communicative networking and control of power generators, consumers and storage systems are known and can be described. • can differentiate between energy transmission networks and distribution networks and distinguish between their main tasks. • learn which intelligent solutions are available or possible in the future for the grid integration of renewable energy sources into the power grid. • can reproduce control structures such as load control, frequency control or voltage control. • will be able to analyze and understand wind data. They can assume a distribution and perform probability calculations. • can calculate the annual energy yield of a wind farm at a given location. • will be able to prepare a technical specification for a wind turbine. • will be able to select specific wind turbines on the market that meet the project specifications. 			

Content:

1. Network resources, generators and consumers:
 - Generators/consumers
 - Transformers
 - Generators
 - Storage facilities
 - Smart metering, intelligent meters
 - Converter technology
 - Grid topologies
2. Grid stability strategies
 - Grid integration, grid stability
 - Forecasting methods
 - Load control/load shifting
3. Energy systems of the future
 - Smart grids
4. Wind Power
 - Technical basics of a wind turbine
 - Evaluating wind data
 - Energy calculation
 - Selection of a wind turbine
 - Use of artificial intelligence in the maintenance strategy
 - Rudiments of power electronics

Literature:

- HAU, Erich, 2013. *Wind turbines: fundamentals, technologies, application, economics ; 41 tables* [online]. Berlin [u.a.]: Springer PDF e-Book. ISBN 978-3-642-27151-9. Available via: <https://doi.org/10.1007/978-3-642-27151-9>.
- REKIOUA, Djamila, . *Wind Power Electric Systems : Modeling, Simulation, Control and Power Management Control* . ISBN 978-3-031-52883-5
- SGUAREZI, Alfeu and others, 2024. *Smart grids - renewable energy, power electronics, signal processing and communication systems applications*. Cham, Switzerland: Springer. ISBN 978-3-031-37908-6, 978-3-031-37911-6

Additional remarks:

The lecture is held in attendance and online.

Sustainability Management			
Module abbreviation:	SCE_SustMgmt_FW	Reg.no.:	35
Curriculum:	Programme	Module type	Semester
	Sustainable Civil Engineering (SPO WS 23/24)	General Elective Subject	4
Responsible for module:	Loza Adai, Cristian Rolando		
Lecturer:	Loza Adai, Cristian Rolando		
Language of instruction:	English	Language of exam:	English
Credit points / SWS:	2 ECTS / 2 SWS		
Workload:	Contact hours:		23 h
	Self-study:		27 h
	Total:		50 h
Subjects of the module:	Sustainability Management		
Lecture types:	SU - lecture		
Availability of the module:	None		
Examinations:			
LN - project work			
Additional Explanation:			
None			
Prerequisites according examination regulation:			
None			
Recommended prerequisites:			
None			
Objectives:			
The students:			
<ul style="list-style-type: none"> • Understand the responsibility of business in modern society and analyze global trends. • Learn to develop leadership strategies that promote sustainability and strengthen intercultural cooperation. • Know how to develop and implement sustainable business and marketing strategies. • Understand and apply the principles of circular economy to promote resource efficiency. • Develop strategies to implement sustainable practices in global supply chains. • Evaluate and implement sustainable investment strategies. 			
Content:			
The modules contains the following content:			
<ul style="list-style-type: none"> • The role of Business in the 21th century • Materiality assessment • Social Responsibility and Impact • Environmental Impact and Assessment 			

- Sustainable Leadership and Governance
- Sustainable Business Models (incl. Marketing)
- Sustainable and circular operations models
- Sustainable Design and Development
- Sustainable Supply Chains
- Sustainable Finance and Investment
- Sustainability Standards and Regulation
- Sustainability Accounting and Reporting

Literature:

- HAHN, Rüdiger, 2022. *Sustainability management: global perspectives on concepts, instruments, and stakeholders*. Fellbach: Rüdiger Hahn. ISBN 978-3-9823211-0-3, 3-9823211-0-7

Additional remarks:

The language of instruction for the module is English. The module is offered exclusively digitally.

As part of the module, you will work in a team with students from Brazilian universities.

THIS EVENT WILL BE RECORDED ON VIDEO:

When you enter the lecture room, you will take note of the recording of the event. This recording can be made publicly available. By entering the room, you consent to the possible unintentional recording of your person. Insofar as individualized verbal contributions on your part are part of the final version of the recording, you can object in writing to the lecturer within 14 days of publication of the final version and your acknowledgement. Your contribution will then be deleted insofar as you can be individualized within the group and the contribution can be directly attributed to you. The recording ends at the end of the event.

Sustainability in Engineering			
Module abbreviation:	NUM_SE_FW	Reg.no.:	35
Curriculum:	Programme	Module type	Semester
	Sustainable Civil Engineering (SPO WS 23/24)	Einsetzungstext ist leer!	4
Responsible for module:	NN,		
Lecturer:	NN, ; Uhde, Julia		
Language of instruction:	English	Language of exam:	English
Credit points / SWS:	2 ECTS / 2 SWS		
Workload:	Contact hours:		23 h
	Self-study:		27 h
	Total:		50 h
Subjects of the module:	Sustainability in Engineering		
Lecture types:	SU/PR - Seminar based teaching/laboratory		
Availability of the module:	None		
Examinations:			
seminar paper (10 slides) with oral presentation (15 min.)			
Additional Explanation:			
None			
Prerequisites according examination regulation:			
None			
Recommended prerequisites:			
None			
Objectives:			
<p>This course aims to provide students with a comprehensive understanding of innovative technologies and other approaches to address the challenges of climate change and reaching sustainable development goals. Students will learn technology concepts of energy, materials, urbanization, environment, hydrology, logistics, artificial intelligence and data science, and others within the solution framework for sustainability goals. In addition, they will be encouraged to develop skills in planning, implementing, operating these solutions, with an emphasis on citizen participation and citizen science to promote the resilience and sustainability in the face of emerging environmental and climate challenges.</p>			
Content:			
<p>The module covers the following content:</p> <ul style="list-style-type: none"> • Introduction - Lecture context and presentation of sustainED • New trends and technologies to address the SDGs • World Energy Outlook and Energy Transition • Life cycle assessment • Climate Change and Carbon Emissions • Renewable Energy Sources 			

- Hydrogen as a vector of decarbonization
- Sustainable Product Development
- Recycling, reuse and repurposing
- Sustainable Construction
- Material resources - sustainability aspects
- Urban Environment - sustainability aspects
- Smart Cities
- Water and sanitation - sustainability aspects
- Mobility and transportation - sustainability aspects
- Sustainable technologies applied to agriculture and forestry
- Global and local logistics - sustainability aspects
- AI and data science applications on sustainability
- Sustainability in manufacturing
- Brazilian and German Perspectives on Technology Application and Development for Sustainability

Literature:

- DUNMADE, Israel Sunday, DARAMOLA, Michael Olawale, IWARERE, Samuel Ayodele, 2024. *Sustainable Engineering: Concepts and Practices* [online]. Cham: Springer International Publishing PDF e-Book. ISBN 978-3-031-47215-2. Available via: <https://doi.org/10.1007/978-3-031-47215-2>.

Additional remarks:

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