TECHNISCHE HOCHSCHULE DEGGENDORF

Module Guide
Master of Healthy and Sustainable Buildings

Faculty European Campus Rottal-Inn

Examination regulations 15.03.2022

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HSB-01 ENVIRONMENTAL PSYCHOLOGY

Module code	HSB-01
Module coordination	Prof. Dr. Irmgard Tischner
Course number and name	HSB-01 Environmental Psychology
Lecturer	Eng. Karolina Machackova
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Weight	5/120
Language of Instruction	English

Module Objective

The design of healthy and sustainably buildings not only requires knowledge of the materials and technology needed for building to be – in themselves – sustainable, but necessitates also some insight into the interactions between humans and their built environments. The module 'Environmental psychology' serves these objectives in various ways: by teaching psychology with a focus on human-environment interaction, as well as providing the foundations in sustainable development. As students will join us with mostly engineering degrees, they will also be introduced to the foundations of psychology to enable them to understand these human-environment interactions.

Environmental psychology itself consists of two strands: the impacts of human behaviour on the environment, and resulting efforts to encourage pro-environmental behaviour, and reversely, environmental influences on human behaviour. Both of these, as well as foundations in sustainable development, are important issues to consider in the design of healthy and sustainable built environments.

Professional and methodological competence:
Students are able to identify environmental influences on human wellbeing, and pro-environmental human behaviour. They will be able to understand, evaluate and apply (environmental) psychological theories and models, and the influences various environmental factors may have on human well-being.

Students know standards (Global Reporting Initiative) of sustainability management, their structure and function. They are able to apply single material topics and to compare the results with the reporting of other companies.

Personal competence:
Students can understand psychological theories and models, evaluate their significance for, and apply them in, their field of work. They are able to see the built environment as a part of the bigger social and cultural system.

Students can understand the significance of different sustainable development topics. Furthermore, they are able to evaluate these topics.

Social competence:
Social competence of students is promoted by the appropriate use of cooperative methods such as group work and moderated discussion.

Applicability in this and other Programs

HSB-19 Master's Thesis

Entrance Requirements

None

Learning Content

- Introduction to psychology, scope of environmental psychology
- Introduction to social and health psychology, with a focus on behaviour change theories and models
- Environmental Psychology and its research methods
- Environmental Stress and Health Benefits of Nature
- Environment and Quality of Life: Urban Environments and working environments
- Introduction to sustainable development
- The reporting of sustainable development: GRI reporting (human rights; labour rights; environmental topics; etc.)

Teaching Methods

Seminaristic teaching combining lectures, exercises, group work, (group) presentations, classroom discussions, as well as one field trip.

Recommended Literature

- Devlin, A.S. (2018) *Environmental Psychology and Human Well-Being*. London: Academic Press
- Marks, D.F., Murray, M. & Vida Estacio, E. (2018) *Health psychology: theory, research & practice*. Los Angeles : Sage
- Steg, L. & deGroot, J.I.M. (eds) (2019) *Environmental Psychology 2E*. Hoboken, NJ: Wiley/BPS

HSB-02 SUSTAINABLE BUILDINGS & NEIGHBOURHOODS

Module code	HSB-02
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-02 Sustainable Buildings & Neighbourhoods
Lecturer	Prof. Dr. Michael Laar Dr. Neveen Solimann
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate
Semester periods per week (SWS)	8
ECTS	10
Workload	Time of attendance: 120 hours self-study: 180 hours Total: 300 hours
Type of Examination	ModA (incl. 1 presentation + written exam 90 min.)
Weight	10/120
Language of Instruction	English

Module Objective

Module Objective

Students learn about challenges and complexities of sustainability on international, national and regional level. They learn the historical development of sustainability, its current state, including the UN SDGs, and possible future scenarios and are able to transfer this knowledge to the specific situation of their country of origin. Furthermore, they understand the role of the construction sector in the quest for sustainability.

Based on a case study, the students understand the concept of sustainable buildings from start to end.

Based on the 25 principles of building biology, the students are able to evaluate examples of vernacular and modern architecture of their country of origin and learn from their peers from different regions of the world. The students understand the connection between sustainable buildings and sustainable neighbourhoods.

Furthermore, students are able to evaluate building materials and substances, used in construction and operation & maintenance of buildings, with a comprehensive set of criteria for sustainability.

The students are capable to apply the newly acquired knowledge in the Module Assignment (ModA), which is being developed during the semester.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the quest for sustainability in its international, national and regional context, including the UN SDGs
- Understand the complexity of sustainability, including its economic, social, cultural and ecological perspectives
- Understand vernacular architecture and its concepts in the context of different climate zones
- Know and understand the 25 principles of building biology and their context
- Understand the context of building and neighbourhood with focus on sustainability
- Understand aspects of sustainability in building materials and substances used in operation & maintenance for their sustainability
- Know and understand Environmental Product Declarations EPDs
- Understand the approach of a sustainable building project

Skills

Upon completion of the module the students will be able to:

- Describe basic concepts of sustainability and its relevance on international, national and regional level and use technical terms adequately
- Describe the ecological footprint and analyse its impact, considering different perspectives
- Describe and exemplify the cradle-to-cradle approach
- Analyse Environmental Product Declarations
- Describe concepts of vernacular architecture in different climate zones
- Transfer adequate concepts of vernacular architecture to contemporary architecture
- Describe building biology principles
- Use building biology principles on a conceptual level to analyse and evaluate vernacular and contemporary architecture in different climate zones

- Evaluate building materials concerning sustainability
- Evaluate substances used in operation & maintenance for their sustainability
- Set up a concept the development of a sustainable building project (new building)
- Set up a concept for the development of a sustainable retrofit building project

Social competence

Students are demonstrating working individually or in small groups to solve problems that aim at enhancing their team-working skills as well as their problem-solving capabilities. Further, Students also know how to work with different groups of stakeholders, understand their perspectives, learn to consider these perspectives in their line of argumentation and act accordingly.

Methodological competence:

The students improve the knowledge in the field of sustainable buildings based on real case studies. The students should be enabled to apply the acquired knowledge and to critically evaluate and inter-present subject-specific information on the basis of criteria of sustainability and specific building biology criteria. Students develop an analytical system-oriented way of thinking and are able to structure the approach for a sustainable building project.

Applicability in this and other Programs

HSB-03 Smart Buildings

HSB-06 Evidence-based Design 1

HSB-07 Standards and Green Building Certification Systems

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

None

Learning Content

- Basics of sustainability: historical development, current situation and future projection
- Ecological footprint

- Analysis of vernacular architecture in different climate zones
- Different stakeholder - different perspectives: how to deal with it
- Evaluation of sustainability of building materials and substances, with focus on sustainable materials
- Environmental Product Declaration (EPD)
- Circular economy: Cradle-to-cradle approach in the construction sector
- 25 Principles of Building Biology
- Building and neighbourhood – synergies in sustainability
- Sustainable and healthy buildings and neighbourhoods: a structured approach

Teaching Methods

Seminaristic teaching / Exercises / tutorials / Module Assignment: Portfolio development + Presentations + coaching / Case studies / Moderated discussions / Lab-work & LivingLab

Remarks

Excursions to landmark projects

Recommended Literature

- Baker-Laporte, P.; Elliot, E.; Banta, J. (2014) *Prescription for a Healthy House. A practical guide for architects, builders and homeowners*. Canada: New Catalyst Books
- Weber, W., Yannas, S. (2014) Lessons from Vernacular Architecture: Achieving Climatic Buildings by Studying the Past. New York: Routledge
- Sekara, V. (2015) *Exterior Green Wall Design*. Images Publishing Dist Ac
- Neufert, E. (2019) *Architects? Data.* 5th Edition. Hoboken, NJ, USA: Wiley Blackwell
- Vegesack, Alexander von; Mateo Kries. (eds.) (2003) *Grow your own home/Simon Velez and bamboo architecture*. Weil am Rhein: Vitra Design Museum
- Herzog, T., Natterer, J., Schweitzer, R., Volz, M., Winter, W. (2004). *Timber Construction Manual*. Basel: Birkhäuser
- Pohl, G., Nachtigall, W. (2015) *Biomimetics for Architecture & Design.* Cham: Springer Publishing International

o Knippers, J.;Schmid, U., Speck, T. (2019) *Biomimetics for Architecture : Learning from Nature.* Berlin : Walter De Gruyter GmbH

HSB-03 SMART BUILDINGS

Module code	HSB-03
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-03 Smart Buildings
Lecturer	Prof. Dr. Michael Laar Prof. Dr. Matthias Huber Prof. xxx (ausgeschrieben) Dipl.-Ing. Michael Bauer
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate
Semester periods per week (SWS)	8
ECTS	10
Workload	Time of attendance: 120 hours self-study: 180 hours Total: 300 hours
Type of Examination	ModA (incl. 1 presentation + written ex. 90 min.)
Weight	10/120
Language of Instruction	English

Module Objective

Module Objective

Students learn the basics of building physics and building climatology within an international perspective, including different climate zones and different building cultures and traditions. The approach includes macro- and micro-climate analysis, heat/cold, acoustics, artificial lighting/daylighting/shading, natural ventilation, moisture and noise protection (fire protection is part of HSB-13 Building Safety and Security).

Students learn the concepts of environmental analytical methods in building related areas, with focus on monitoring and analysis of physical, chemical and biological factors.

Students learn basic concepts of smart buildings for different building types.

The students are capable to apply the newly acquired knowledge in the Module Assignment (ModA), which is being developed during the semester.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the basic concepts of building physics and building climatology
- Know different climate zones and its corresponding sustainable building concepts
- Understand the basics of building energy balance and relevant criteria of different building materials and systems
- Know and understand different aspects of Indoor Environmental Quality and its impact on health and comfort
- Know significant threshold values concerning Indoor Environmental Quality
- Students are able to explain and reproduce basic theories, principles, and methods related to:
- Fundamentals of measuring physical quantities
- Measuring methods, devices and instruments
- Analysis and processing of measurement results
- Buildings and indoor environments, and associated physical, chemical and biological factors and quantities
- Continuous monitoring and sampling of environmental parameters
- Analytical methods of physical and chemical analysis
- Analytical methods of biological analysis
- Main exposure limits to harmful factors in living areas and workplaces

Skills

Upon completion of the module the students will be able to:

- Analyse local climate and propose correct sustainable building concepts
- Calculate simple building energy balances
- Correctly name significant threshold values concerning Indoor Environmental Quality
- Evaluate building envelope materials concerning effects on building energy balance and indoor comfort
- Preselect building materials for Building Simulation Performance software

- Develop a consistent concept for different smart building types
- Measurement and analysis of various physical signals and quantities
- Employing basic measurement instruments
- Evaluating problems of metrology and to apply methods for describing and processing of measurements
- Selecting and applying the appropriate measurement and analysis method
- Evaluating the measurement results and of related errors and uncertainties
- Employing software tools for measurement, data analysis and processing
- Applying theoretical concepts to practical applications

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities. Furthermore, students also know how to work with different groups of stakeholders, understand their perspectives, learn to consider these perspectives in their line of argumentation and act accordingly.

Methodological competence:

The students improve their knowledge in the field of building physics and building climatology and are able to deduce from climate analysis correct concepts for climate adapted building designs. With the newly acquired knowledge they are able to pre-select materials and systems for the building envelope, taking into consideration the effects on the building energy balance and the indoor comfort. The students are able to apply their newly acquired knowledge in the course of the portfolio development (ModA - Module Assignment) during the semester.

The students are capable to develop a concept for physical, chemical and biological measurements in building related areas and carry out these measurements for tasks of low complexity.

The students are able to develop a consistent concept for different types of smart building.

Applicability in this and other Programs

HSB-02 Sustainable Buildings & Neighbourhoods

HSB-06 Evidence-Based Design 1

HSB-07 Standards and GB Certification Systems

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

None

Learning Content

Building physics / Building Climatology

- Definition and scope of Building physics/building climatology
- Introduction into the development of energy efficiency, building performance simulation programs and Green Building Certification systems nationally and internationally
- Analysis of Marco- and micro-climate
- Climate, comfort and strategies of planning sustainable buildings
- Indoor Environmental Quality
- Energy balance of buildings
- Glazing
- Sun chart & planning of shading devices
- Artificial lighting / Daylighting
- Natural ventilation

Fundamentals of environmental analytical methods of measurement and analysis of indoor and building related factors

- Measurement parameters, unit systems, standards
- Signals, characterization, conversion
- Measuring methods and devices, basic instruments
- Evaluation of measurement results, errors and uncertainties
- Measurement of electrical quantities and non-electrical physical quantities
- Measurement of indoor environmental factors and their harmful components

- Monitoring, Sampling and Analysis
- Physical factors: fields, waves, radiation
- Chemical factors: gases, volatile organic compounds and chemicals
- Biological factors: bioaerosols, fungi, bacteria
- Dust and Particulates
- Continuous monitoring, sensors and detectors, sensitivity and selectivity
- Sampling approaches and methods
- Analytical methods: physical and chemical analysis, bioassays
- Principles of gas and liquid chromatography
- Spectroscopy methods: ultraviolet, visible, infrared and Raman spectroscopy
- Analytical voltammetry and polarography
- Fluorescence: UV and X-Ray spectrometry
- Microscopy
- Bioassays and Techniques for DNA Analysis
- Standards and exposure limits

Smart Buildings

- Historical development of Smart Buildings
- Planning concepts of Smart Buildings

Teaching Methods

Seminaristic teaching / Exercises / Module Assignment: Development of projects + presentation + Coaching / homework / Case studies / Lab-work & LivingLab

Remarks

Excursion to landmark project

Recommended Literature

- Leimer, H.-P. (2016) Bauphysik/Building Physics. Munich: Hanser-Verlag
- Hausladen, G. Liedl, P., de Saldanha, M. (2011) *Building to suit the climate ? a handbook*. Munich: Birkhäuser

- Sinopoli, J. (2009) *Smart Building Systems for architects, owners and builders*. USA: Butterworth-Heinemann
- Ferrero, A., Petri, D., Carbone, P., Catelani, M. (2015) *Modern Measurements: Fundamentals and Applications*, Wiley
- Bartiromo, R., De Vincenzi, M. (2016) *Electrical Measurements in the Laboratory Practice*. Springer
- Bentley, J. (2004) *Principles of Measurement Systems*. Pearson - Prentice Hall
- Hess-Kosa, K. (2018) *Indoor Air Quality: The Latest Sampling and Analytical Methods.* CRC Press
- Jeffrey S, Gaffney, N., Marley, A. (2019) *Chemistry of Environmental Systems: Fundamental Principles and Analytical Methods*. John Wiley & Sons
- Pohl, G., Nachtigall, W. (2015) Mimimetics for Architecture and Design. Berlin: Springer
- Lechner, N. (2015) *Heating, Cooling, Lighting - Sustainable Design Methods for Architects.* Hoboken, New Jersey/USA: John Wiley & Sons
- Lechner, N. (2015) *Plumbing, Electricity, Acoustics - Sustainable Design Methods for Architects.* Hoboken, New Jersey/USA: John Wiley & Sons

HSB-04 QUANTITATIVE AND QUALITATIVE RESEARCH METHODS

Module code	HSB-04
Module coordination	Prof. Dr. Dieter Rummler
Course number and name	HSB-04 Quantitative and Qualitative Research Methods
Lecturers	Prof. Dr. Dieter Rummler
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Research project
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Acquiring a comprehensive understanding of fundamental mathematical and statistical concepts; being able to apply mathematical and statistical methods to complex problems. Acquiring a good understanding of qualitative methods and how and when to use them.

The following skills are acquired in this course:

Professional competence

In Quantitative Research:

Students are familiar with the scientific research process and have basic knowledge of the quantitative research approach (e.g. main study designs, sampling, data management). They conceive issues of descriptive statistics within the context of the quantitative research approach. They know and calculate descriptive parameters like measures of central tendency and dispersion. They have basic knowledge of the statistical software R and present statistical results according to scientific standards.

In Qualitative Research:

In relation to qualitative methods students will gain knowledge of different qualitative research designs, as well as methods of qualitative data collection and analysis. Students will further understand ethical requirements in research with human participants.

Social competence

Students train their ability for abstract thinking by working with statistical concepts, as well as different epistemological and ontological perspectives in research. They increase their ability of self-organisation by going further into the topic and solving exercises in private study.

Applicability in this and other Programs

HSB-18 R&D project

HSB-19 Master's Thesis

Entrance Requirements

Basic computer literacy

Learning Content

In Quantitative Research:

- Quantitative research approach: research question, study design, data collection, data management
- Summary statistics: mean, mode, median, range, interquartile range, standard deviation
- Presentation of results: pie charts, bar plots, histograms, box plots, tables
- R software: installation, getting help, basic objects, data import, scripts, commands for parameter calculation

Qualitative Research:

- Introduction to qualitative research and its distinction from quantitative designs
- Designing qualitative research, including issues of different perspectives; choosing the research topic and designing the research question; the limitations and advantages of qualitative designs
- Methods of qualitative data collection: An overview of the different methods of data collection available, and their pros and cons

- An overview of how the data can be analysed to achieve the set objectives
- Ethical issues in research with human participants

Teaching Methods

Lecture, exercises, group work

Recommended Literature

Statistics:

- Rumsey, D. (2017). *Statistics workbook for dummies*. Weinheim: Wiley.
- Weiss, N.A. (2017). *Introductory Statistics*. Boston: Pearson.
- Bland, M. (2015). *An introduction to medical statistics*. Oxford: Oxford University Press.
- Kabacoff, R.I. (2015). *R in action*. Shelter Island: Manning.
- Jacobsen, K.H. (2017). *Introduction to health research methods. A practical guide*. Burlington, MA: Jones & Bartlett

Qualitative Methods:

- Braun, V. & Clarke, V. (2013) Successful Qualitative Research – a practical guide for beginners. London: SAGE
- Flick, U. (2014) An Introduction to Qualitative Research. London: SAGE
- Willig, C. (2013) Introducing Qualitative Research in Psychology. Maidenhead: McGrawHill/Open University Press

HSB-05 ENVIRONMENTAL HYGIENE AND MEDICINE

Module code	HSB-05
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-05 Environmental Hygiene and Medicine
Lecturer	Dr. Christian Scherer
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Students learn about challenges and complexities of environmental hygiene and medicine in buildings. They learn the historical development of hygiene and environmental medicine. Furthermore, they learn about Principles of Human Toxicology and Ecotoxicology, toxicity, Chemistry of the Atmosphere, Building Related Disorders, Allergies and Asthma, Indoor Environment, Indoor air quality and potential pollutants, Sources of pollutants, Human Toxicity and Ecotoxicity of Construction Materials, intake of Selected Contaminants, Emissions from building products, Testing and Evaluation, Regulations, Building Certification systems, Workplace Safety vs. Indoor Environment Quality and labelling schemes.

The students are able to evaluate accordingly building materials and substances, used in construction and operation & maintenance of buildings. They are able to consider aspects of Environmental hygiene and Medicine in the development of the consulting and/or planning projects.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

o Know the different aspects of environmental hygiene and medicine

- Understand its possible impacts on the development of building projects
- Know different approaches to guarantee minimum standards, including economic, financial and socio-cultural aspects

Skills

Upon completion of the module the students will be able to:

- Analyse existing problems, and potential future challenges and threats concerning environmental hygiene and medicine in existing buildings
- Analyse potential challenges and threats concerning environmental hygiene and medicine in building projects
- Determine where experts in the field of environmental hygiene and medicine have to be integrated into the design team
- Obtain pro-actively relevant norms and guidelines in different project countries
- Develop adequate solutions in specific building projects
- Communicate adequately with experts in the field of environmental hygiene and medicine
- Address adequately related credits in green building certification systems and healthy building certification systems

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities.

Methodological competence:

The students improve the knowledge in the field of Environmental hygiene and medicine. The students should be enabled to apply the acquired knowledge and to critically evaluate and inter-present subject-specific information on the basis of criteria of environmental hygiene and medicine. Students develop an analytical system-oriented way of thinking and are able to structure the approach for healthy building projects.

Applicability in this and other Programs

HSB-06 Evidence-based Design 1

HSB-07 Standards and Green Building Certification Systems

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings

HSB-03 Smart Buildings

Learning Content

- Definitions
- History
- Principles of Human Toxicology
- Principles of Ecotoxicology
- Toxicity
- Chemistry of the Atmosphere
- Building Related Disorders
- Allergies and Asthma
- Indoor Environment
- Indoor Pollutants & Sources
- Human Toxicity and Ecotoxicity of Construction Materials
- Ingestion of Selected Contaminants
- Testing and Evaluation
- Regulations
- Indoor air quality
- Workplace Safety vs. Indoor Environment Quality
- Labelling Schemes

Teaching Methods

Seminaristic teaching / Exercises / homework / Case studies / Lab-work & livingLab

Remarks

Excursion to National Research Facility

Recommended Literature

Principles of Human Toxicology

- Klaassen, C.D.; John B. Watkins III (Eds.) (2015): *Casarett & Doull's Essentials of Toxicology*. 3rdEdition; New York: McGraw Hill Medical
- Klaassen, C.D. (Ed.) (2019): *Casarett & Doulls Toxicology - The Basic Science of Poisons*. 9th Edition: New York: McGraw Hill Education
- Brusseau, M. L., Pepper, I.L., Gerba, C.P. (2019): *Environmental and Pollution Science*. 3rd Edition; Academic Press

Chemistry of the Atmosphere

- Hewitt, N., Jackson, A.V. (2020): *Atmospheric Science for Environmental Scientists*. 2nd Edition; Wiley Blackwell;
- Yanagisawa,Y., Yoshino,H., Ishikawa, S., Miyata, M. (2017): *Chemical Sensitivity and Sick-Building Syndrome.* CRC Press

Indoor Environment

- Kishi, R., Norbäck, D., Araki, A. (Eds.) (2020): *Indoor Environmental Quality and Health Risk toward Healthier Environment for All in Current Topics in Environmental Health and Preventive Medicine*. Singapore: Springer Nature Singapore Pte Ltd

Indoor Pollutants

- Pacheco-Torgal, F., Jalali, S., Fucic, A. (Eds.) (2012): Toxicity of Building Materials; Cambridge, UK: Woodhead Publishing
- Zwiener, G. Lange, F.-M. (Eds.) (2012): *Handbuch Gebäude-Schadstoffe und Gesunde Innenraumluft*. Erich Schmidt Verlag
- D'Mello, J. P. F. (Ed.) 2020): *A Handbook of Environmental Toxicology – Human Disorders and Ecotoxicology*; Wallingford UK: CAB International
- Newman, M.C. (2019): *Fundamentals of Ecotoxicology: The Science of Pollution*. 5th Edition; CRC Press

HSB-06 EVIDENCE BASED DESIGN 1

Module code	HSB-06
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-06 Evidence Based Design 1
Lecturer	Prof. Dr. Michael Laar Dr. Neveen Soliman Dipl.-Ing. Doppler, architect
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	ModA (incl. presentation 15 min.)
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Students learn the concept of Evidence-based Design in the area of residential and school buildings and are able to use the newly acquired knowledge to develop projects with this specific focus. The student develops during the semester a portfolio (Module Assignment ModA), analyzing social, economic, ecological and cultural evidence in the selected area, and designing a project accordingly.

The module counts with keynote lectures from internal and external professionals of the focus areas.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the concepts of Evidence-based Design
- Know where and how to find latest relevant knowledge, including research results, in the area of Evidence-based Design for residential buildings and schools.

- Understand the connection between design decisions, health, productivity and investment costs
- Know the process of life-cycle-analysis
- Understand the role of different stakeholders in the planning process of sustainable buildings

Skills

Upon completion of the module the students will be able to:

- Analyse the specific needs of the client
- Analyse the necessary fields of competence and decide which further experts have to be invited to the design team
- Organize relevant information concerning specific building type design concepts, regulations and recommendations
- Apply relevant knowledge in the design of residential and school buildings
- Evaluate different design options concerning health, productivity and investment costs, as well as operation & maintenance costs

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Presenting their project, they learn how to address clients and enhance their social communication skills.

Methodological competence:

The students improve their knowledge in the field of Evidence-based Design in the area of residential buildings and schools and are able to evaluate different design option. With the newly acquired knowledge they are able to pre-select design solutions, taking into consideration the effects on tenant's health, productivity and well-being. The students develop individual portfolios, including analysis of social, economic, environmental and cultural aspects of their countries of origin or any location of their choice, and develop an individual project accordingly.

Furthermore, the students are able to evaluate and decide upon preliminary solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-07 Standards and Green building certification systems

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings

HSB-03 Smart Buildings

Learning Content

- Introduction into Evidence-based Design
- Different aspects of Evidence-based Design concerning residential buildings and schools, considering different climate zones
- Life-cycle-assessment
- Life-cycle-cost-assessment
- Economic consequences of Evidence-based Design
- Building Certification Systems for Healthy buildings - selected criteria
- Planning of a school building under specific conditions of the students' region of origin

Teaching Methods

Seminaristic teaching / Module Assignment: Portfolio Development + Presentation + Coaching / tutorials / homework / Case studies / Lab-work & livingLab

Remarks

Excursion to landmark project

Recommended Literature

Different buildings types

- Hamilton Kirk D.; Watkins, David H. (2009) *Evidence-Based Design for Multiple Building Types: Applied Research-based Knowledge for Multiple Building Types*. USA: Wiley

Health Care Buildings

- Hamilton, Kirk (2016) *Design for Critical care: an evidence-based approach*. London : Routledge

Residential buildings

- Magwood, C. (2017) *Essential Sustainable Home Design: A Complete Guide to Goals, Options, and the Design Process.* New Society Publishers

School buildings

- Clipson CW, Johnson RE (1987). *Integrated approaches to facilities planning and assessment. Planning for Higher Education*. **15** (3): 12?22
- Sheninger, E., Murray, T. (2017) *Learning Transformed: 8 Keys to Designing Tomorrow's Schools, Today*. ASCD
- Gelfand, L., Freed, E.C. (2010) Sustainable School Architecture: Design for Elementary and Secondary Schools. USA:Wiley
- USGBC (2019) *LEED BD+C: Schools.v4*. USA: USGBC

HSB-07 STANDARDS & GREEN BUILDING CERTIFICATION SYSTEMS

Module code	HSB-07
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-07 Standards & Green Building Certification Systems
Lecturers	Prof. Dr. Michael Laar Dr. Neveen Soliman
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	ModA
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Students learn national and international building standards relevant to sustainable and healthy buildings.

Students learn the concept of Building Certification System for different building types and neighbourhoods. Furthermore, the students are introduced into the application process and train on selected credits the concrete application in Evidence-Based Design 1 +2, and Evidence-based Design 1 – Consolidation, if selected.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the organization of international, national and regional standards
- Know the most relevant standards for sustainable and healthy buildings
- Understand the concept and approach of Green Building Certification systems.

- Understand the concept and approach of Healthy Building Certification systems.
- Know most relevant certification systems in the area of sustainable and healthy buildings
- Know where and how to find latest relevant knowledge, including research results, in the area of Green Building and Healthy Building Certification systems.

Skills

Upon completion of the module the students will be able to:

- Explain the applicability of international, national and regional standards and their importance for sustainable and healthy buildings
- Explain concept, approach and benefits of different certification systems
- Select the most adequate certification system
- Organize workgroups and workflow for certifications
- Prepare documentation for the certification process

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities. They communicate adequately with different stakeholder and experts.

Methodological competence:

The students improve their knowledge in the field of Green Building and Healthy Building certification systems and are able to organize workgroups and workflow for the certification. With the newly acquired knowledge they are able to select the most adequate systems and organize and prepare the necessary documentation for certification processes. The students apply selected credits in the Module Assignments Evidence-based Design 1+2, and, if selected, in Evidence-based Design 2 – Consolidation.

Applicability in this and other Programs

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings

HSB-03 Smart Buildings

Learning Content

- Standards – internationally, nationally, and regionally – an introduction
- PassivHaus Standard, KfW standards
- Most relevant standards for sustainable and healthy buildings
- Standards and their importance for Certification systems
- Introduction into different Green Building Certification Systems – concept, structure and approach
- Introduction into different Healthy Building Certification Systems – concept, structure and approach
- Analysis of most relevant criteria
- Economic aspects of certification systems
- Certification process as teamwork: how to organize work group and workflow
- Applicability of certification systems in different countries and climate zones

Teaching Methods

Seminaristic teaching / group work / homework / Case studies / Module Assignment + coaching / Lab-work

Recommended Literature

- ASHRAE (2019). *ASHRAE Handbook—HVAC Applications. USA*
- ASHRAE (2018) *ASHRAE Handbook—Refrigeration. USA*
- ASHRAE (2017) *ASHRAE Handbook—Fundamentals*. USA
- ASHRAE (2016) ASHRAE *Handbook—HVAC Systems and Equipment*. USA
- USGBC (2019) *LEED Reference Guide for Building Design and Construction version 4.0*. USA: USGC

- FITWEL (2019) *Reference Guide for the Fitwel Certification System MULTIFAMILY RESIDENTIAL*. USA:Center for Active Design
- DGNB (2020) DGNB – System – New Construction Building Certification Criteria Set. Version 2020 International. Germany : DGNB

HSB-08 BUILDING PERFORMANCE SIMULATIONS

Module code	HSB-08
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-08 Building Performance Simulations
Lecturer	Prof. Dr. Michael Laar Prof. Dr.-Ing. Matthias Huber
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Building Performance Simulations are an important tool for the design of sustainable and healthy buildings.

Students learn the concept of Building Performance Simulations for different areas and are able to apply this knowledge in practice. Results of building performance simulation will be used in the module "Evidence-based Design 2" and, if chosen, in the Module "Evidence-based Design 1 – Consolidation". Furthermore, students learn the concept of BIM – Building Information Modeling – and are able to use it in small scale in their projects.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the concepts of Building Performance Simulations, taking into consideration different climate zones
- Know where and how to find latest relevant knowledge, including research results, in the area of Building Performance Simulations.

- Know different building performance simulation tools and their adequate area of application
- Understand the connection between design decisions, health, productivity and investment costs in the focus area.
- Are aware of the challenges of Building Performance Simulations
- Understand the concept of Building Information Modeling (BIM)

Skills

Upon completion of the module the students will be able to:

- Perform parameter studies for different areas, focusing on energy efficiency and Indoor Environmental Quality parameter
- Use building performance simulation tools to optimize building layout
- Use building performance simulation tools to optimize selection of systems and materials
- Use building performance simulation tools to calculate cost-benefit relation for different solutions
- Prepare climate data for projects worldwide
- Use aspects of building information modeling (BIM) in Module Assignments (ModA)

Social competence

Students are demonstrating competence working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students? intercultural interaction capabilities.

Methodological competence:

The students improve their knowledge in the field of Building Performance Simulations for different building types and are able to evaluate different design options for specific climatic conditions. With the newly acquired knowledge they are able to improve design solutions, taking into consideration the effects on tenant’s health, productivity and well-being. The acquired knowledge will be applied in Evidence-based Design 2 and, if chosen, Evidence-based Design 1 – consolidation.

Furthermore, the students are able to evaluate and improve solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-07 Standards and Green Building Certification Systems

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

HSB-15 Evidence-based Design 1 - Consolidation

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings & Neighborhoods

HSB-03 Smart Buildings

Learning Content

- Introduction into Building Performance Simulations
- Concept and structure of Parameter studies
- Building Performance Simulations: Thermal & visual comfort, energy consumption
- Building Performance Simulation: Acoustic comfort
- Building Performance Simulation: Moisture check
- Heating, Ventilation & Air Conditioning (HVAC)
- Solar Energy Systems Performance
- Climate data bank usage
- Building Performance Simulation and Green Building Certification Systems
- Building Information Modeling (BIM) concept

Teaching Methods

Seminaristic teaching / IT-lab work / tutorials / homework / Case studies

Recommended Literature

Software tutorials

HSB-09 SUSTAINABLE ENERGY SUPPLY SYSTEMS

Module code	HSB-09
Module coordination	Prof. Dr. Matthias Huber
Course number and name	HSB-09 Sustainable Energy Supply Systems
Lecturer	Prof. Dr.-Ing. Tobias Bader
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Students learn the concept of Sustainable Energy Supply Systems and are able to use the newly acquired knowledge to develop projects with this specific focus.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the basic concepts of Sustainable Energy Supply Systems for the building sector
- Understand chances and limitations of each system, including of different combinations.
- Know where and how to find latest relevant knowledge, including research results, in the area of Sustainable Energy Supply Systems.
- Know relevant criteria used in Green Building Certification Systems and Healthy Building Certification Systems.

Skills

Upon completion of the module the students will be able to:

- Apply relevant knowledge in the design of different solutions.
- Evaluate economic, social and environmental benefits of different systems.
- Apply relevant criteria demanded by certification systems.

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities. The project work can be carried out in cooperation with students from the Bachelor program Energy Systems Engineering and/or students from the Bachelor program Industrial Engineering.

Methodological competence:

The students improve their knowledge in the field of Sustainable Energy Systems and are able to evaluate and different design option, proposing the most adequate one. With the newly acquired knowledge they are able to pre-select design solutions, taking into consideration the economic, social and environmental consequences.

Furthermore, the students are able to evaluate and decide upon preliminary solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-18 R&D project

HSB-19 Master' thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings & Neighborhoods

HSB-03 Smart Buildings

Learning Content

- Introduction into Energy production, distribution and consumption and its economic, social and environmental consequences
- Basic principles of thermodynamics
- Systems:
  - Thermal solar systems
  - Passive solar systems
  - Photovoltaic systems
  - Heat pumps
  - Solar cooling systems
  - Small wind generators
  - Biomass
  - Small hydro generators
  - Co-generation
  - District heating and Cooling
- Evaluation & Selection process
  - Technical aspects
  - Social aspects
  - Economic & financial aspects
  - Environmental aspects
  - Operation & Maintenance

Relevant criteria of Green Building Certification Systems and Healthy Buildings Certification Systems

Teaching Methods

Seminaristic teaching / Planning Project (residential) / tutorials / homework / Case studies / Lab-work & LivingLab

Recommended Literature

- Boyle, G. (eds.) (2012) Renewable energy: power for a sustainable future. 3rd Edition, Oxford University Press
- Cengel, Y., Boles, M. (2012) *Thermodynamics: An Engineering Approach*. 9th Edition, McGraw Hill Education
- McCrea, Andy (2013) *Renewable Energy.* The Crowood Press Ltd; edition: Hoboken, New Jersey/USA
- Quaschning, V. (2019) *Renewable Energy and Climate Change*. 2nd Edition, John Wiley & Sons, Incorporated

HSB-11 INTERNATIONAL PROJECT MANAGEMENT AND IMPLEMENTATION

Module code	HSB-11
Module coordination	Prof. Dr. Michelle Cummings-Koether
Course number and name	HSB-10 Project Management and Implementation
Lecturer	Prof. Dr. Michelle Cummings-Koether
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	ModA (incl. 2 presentations)
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Students will learn about the processes involved in project management and implementation in international settings. Beginning with the process of building and leading international project team, to project management theory and steps, to finally looking at the implementation of successful project management, this course aims to provide a complete picture of international project management in practice. Additionally, different types of project management will be compared, so that the students will be able to apply the most effective method, based on the type of project and/or team that they are dealing with.

Professional Competence

Knowledge

After successfully finishing the module, students should:

- Understand project management theory and its application
- Understand all the steps involved in project management
- Understand the different roles involved with project management

- Understand how project management teams work together or are put together in different international environments
- Understand how to choose the correct type of project management method for different types of projects
- Understand the different steps in project management and show these on a theoretical in class project
- Understand the challenges and typical project "fails" in implementation of project management
- Understand how effective project management leadership works in different international environments

Skills

Upon completion of the module the students will be able to:

- Transfer theoretical knowledge of project management real world projects
- Determine which project management method is most effective in different situations
- Manage a project and put together an international team to oversee and implement the project effectively
- Recognize the signs when a project is not working or failing
- Work on different projects in various international environments

Social competence

Students will work together on an in-class projects in small groups, in order to learn how to work efficiently with each other on solve problems and on implementing their knowledge together. This aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities.

Methodological competence:

The students will learn how to transfer theoretical knowledge into a project, and hence, will be able to apply their learned skills. This leads to greater retention of the learned theory, and enables transference skills. Further, the students will be provided with an overview of different sets of skills and theory and will be able to choose the most efficient approach to applying these. Students will develop an analytical system-oriented way of thinking and should able to structure the most effective approach to international project management from different aspects, beginning with planning, selection, to implementation.

Applicability in this and other Programs

HSB-07 Standards and GB Certification Systems

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

Entrance Requirements

None

Learning Content

- Project management theories
- Project roles and stakeholders
- Project management theories
- Project roles and stakeholders
- Project management steps
- Project management in international environments – cultural differences
- Project management leadership
- Project management teams
- Project management implementation in international environments
- Project management failures

Teaching Methods

Interactive lecture, case studies, in-class project, group work, discussions and presentations of work in progress.

Recommended Literature

- Berkun, S. (2008). *Making Things Happen: Mastering Project Management (Theory in Practice).* Sebastopol, CA: O'Reilly Media.
- Brinkmann, U. (2014). *Intercultural Readiness: Four Competences for Working Across Cultures.* London: Palgrave Macmillan.

- Edge, J. (2018). *Agile: An Essential Guide to Agile Project Management, The Kanban Process and Lean Thinking + A Comprehensive Guide to Scrum*. Luxemburg: CreateSpace Independent Publishing Platform
- Kunow, A. (2019). *Project Management & Business Coaching: Agile project management - target-oriented and efficient with active body language & comprehensive communication*. Buchum, Germany: KISP Bücher.
- Lane, H.W. & Maznevski, M.L. (2019). *International Management Behavior: Global and Sustainable Leadership*. Cambridge, UK: Cambridge University Press.
- Levitt, G. (2019). *Team Planning for Project Managers and Business Analysts (ESI International Project Management).* Abingdon, UK: Taylor & Francis Ltd.
- Martinelli, R.J., Milosevic, D.Z. (2016). *Project Management ToolBox - Tools and Techniques for the Practicing Project Manager*. Hoboken: Wiley.
- Project Management Institute (Eds.) (2013). *A guide to the project management body of knowledge. PMBOK(R) Guide*. Newtown Square, PA: Project Management Institute.

HSB-12 AMBIENT ASSISTED LIVING & WORKING

Module code	HSB-12
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-12 Ambient Assisted Living & Working
Lecturer	Prof. Dr. Michael Laar Prof. Dr. Horst Kunhardt Dr. Neveen Soliman
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	ModA (incl. Presentation 15 min.)
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Societies are ageing and new technologies can improve the quality of living of elderly people and persons with special needs.

Students learn the concept of Ambient Assisted Living & Working and are able to use the newly acquired knowledge to develop projects with this specific focus. They learn to analyse different social, economic and health aspects related to this area and are able to apply the newly acquired knowledge in a portfolio development, including a small design project, in the course of the semester.

The module counts with keynote lectures from internal and external professionals of the focus areas.

Professional competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the basic concepts of Ambient Assisted Living and Working
- Understand the limitations through age by having used the age-simulation suit and a wheelchair in different situations
- Understand the situation of the target group in their country of origin and in Germany
- Understand innovative design concepts for modern work environments to foster health and productivity.
- Know where and how to find latest relevant knowledge, including research results, in the area of Ambient Assisted Living and Working.
- Know relevant criteria with this specific focus used in Green Building Certification Systems and Healthy Building Certification Systems.

Skills

Upon completion of the module the students will be able to:

- Analyse the specific needs of the target group
- Evaluate different technologies and design concepts
- Implement passive and active concepts and solutions accordingly in order to reduce or even overcome the problems caused by analysed and synthesized limitations.
- Apply relevant knowledge in the design of different buildings types, like residential buildings, schools, health buildings and tourism buildings.
- Evaluate economic, social and environmental benefits of Ambient Assisted Living.
- Apply relevant criteria demanded by GB and HB certification systems.

Social competence

Students are gaining awareness of limitations imposed by age or accident. They can address with empathy these limitations. The portfolio development (Module Assignment) can optionally be carried out in cooperation with students from Master International Tourism Development and Master Medical Informatics.

Methodological competence

The students improve their knowledge in the field of Ambient Assisted Living & Working and are able to evaluate and different design option, proposing the most adequate one. With the newly acquired knowledge they are able to pre-select design solutions, taking into consideration the effects on tenant's health, productivity and well-being. Using an age-simulating-suit and a wheelchair, they experience first-hand the challenges a significant part of population is facing.

Furthermore, the students are able to evaluate and decide upon preliminary solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-07 Standards and GB Certification Systems

HSB-09 Refurbishment, Renovation

HSB-14 Evidence-based Design 2

HSB-16 R&D Project

HSB-17 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings

HSB-03 Smart Buildings

Learning Content

- Introduction into Ambient Assisted Working & Living – the origins, current situation and tendencies
- Assessment of international and national situation
- Limitations through age or accidents/disabilities – experience with an Age-simulation suit & a wheelchair
- Passive and active measures of Ambient Assisted Working & Living
- Concept development for different building types
- Building Certification Systems for Healthy buildings – focus on Ambient assisted Working & Living
- Planning of a residential building using Ambient Assisted Living concepts

Teaching Methods

Seminaristic teaching / Module Assignment: Portfolio-Development + Presentation + Coaching / tutorials / homework / Case studies / Lab-work

Remarks

Excursion

Recommended Literature

- Garcia, Nuno M., Rodrigues, Joel Jose P.C.(2015). *Ambient Assisted Living*. CRC Press

HSB-13 BUILDING SAFETY & SECURITY

Module code	HSB-13
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-13 Building Safety & Security
Lecturers	Dipl.-Ing. Christin Brunken Dr. Neveen Solimann Prof. Dr. Rui Li Eng. Michael Bauer
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	ModA (incl. Presentation 15 min.)
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Students learn the concept of building safety and security and are able to use the newly acquired knowledge to develop projects with this specific focus.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the basic concepts of Building Safety and Security
- Know where and how to find latest relevant knowledge, including research results, in the area of Evidence-based Design for health and tourism buildings.
- Understand the connection between design decisions, health, productivity and investment costs in the focus area.

Skills

Upon completion of the module the students will be able to:

- Analyse and formulate the specific needs of clients
- Develop tailor-made solutions for different groups of clients
- Apply relevant knowledge in the planning of new buildings and neighbourhoods
- Use relevant knowledge in the planning of refurbishment and renovation
- Apply relevant knowledge during the construction phase
- Use relevant during operation and maintenance of the building
- Evaluate different options concerning safety, security, health, productivity and investment costs, as well as operation & maintenance costs in the focus area

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities.

Methodological competence:

The students improve their knowledge in the field of Building safety and security and are able to analyse specific demands and evaluate different design options for specific climatic conditions. With the newly acquired knowledge they are able to pre-select design solutions, taking into consideration the effects on tenant's safety, security, health, productivity and well-being.

Furthermore, the students are able to evaluate and decide upon preliminary solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-07 Standards and GB Certification Systems

HSB-13 Evidence-based Design 2

HSB-14 Refurbishment, Renovation

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

HSB-02 Sustainable Buildings & Neighborhoods

HSB-03 Smart Buildings

Learning Content

Introduction into Building Safety and Security

Building Safety

- Fire Safety and Explosion
- Escape Plan and Rescue Routes
- Electrical and Mechanical faults (Power Failure, Elevator Failure)
- Smoke and Heat Extraction systems
- Plumbing Failure and Flooding
- Earthquake
- Special topic: reactor safety – how to keep a reactor safer in an advanced building (vessel)

Work safety

- Work safety: introduction, history, Laws and by-laws in Germany
- Hazardous substances and corresponding symbols
- Exposition scenarios, particulate matter and micro-bacterial exposure
- Radiations and Vibrations
- Risk assessment

Building Security

- Building Security Concepts and Systems
- Special topic: Fire Protection

Teaching Methods

Seminaristic teaching / Module Assignment: Portfolio-Development + Presentation + Coaching / tutorials / homework / Case studies / Lab-work

Recommended Literature

- Charles E. Thomas (2011) *Process Technology: Safety, Health, and Environment*, Cengage Learning
- Deutsche Gesetzliche Unfallversicherung e.V. (2012) *Machine Tool Fire and Explosion Prevention and Protection* (Information book in English)
- Neufert, E. (2019) *Architects? Data. 5th Edition*. Hoboken, NJ, USA : Wiley Blackwell

HSB-13 EVIDENCE-BASED DESIGN 2

Module code	HSB-13
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-13 Evidence-based Design 2
Lecturer	Prof. Dr. Michael Laar Prof. Dr. Sascha Kreiskott Prof. Dr. Katerina Volchek (Tourism) Prof. Dr.med. Georgi Chaltikyan (Heath Infrastructure) Prof. Dr. Horst Kunhardt (Health Infrastructure & Digitalization) Prof. Dr.-Ing. Tobias Bader
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	ModA (incl. Presentation 15 min.)
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Students learn the concept of Evidence-based Design in the area of health, tourism and office buildings and are able to use the newly acquired knowledge to develop projects with this specific focus. The student develops during the semester a portfolio, analyzing social, economic, ecological and cultural evidence in the selected area, and designing a project accordingly. The development of the project will be supported by Building Performance Simulations and orientated by Green Building Certification systems.

The module counts with keynote lectures from internal and external professionals of the focus areas.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the concepts of Evidence-based Design
- Know where and how to find latest relevant knowledge, including research results, in the area of Evidence-based Design for health buildings and tourism buildings.
- Understand the connection between design decisions, health, productivity and investment costs
- Understand the role of different stakeholders in the planning process of sustainable buildings

Skills

Upon completion of the module the students will be able to:

- Analyse the specific needs of the client
- Analyse the necessary fields of competence and decide which further experts have to be invited to the design team
- Organize relevant information concerning specific building type design concepts, regulations and recommendations
- Apply relevant knowledge in the design of health, tourism or office buildings
- Evaluate different design options concerning health, productivity and investment costs, as well as operation & maintenance costs

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Presenting their project, they learn how to address clients and enhance their social communication skills.

Methodological competence:

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities. The project work can optionally be carried out in cooperation with students from Master International Tourism Development.

Applicability in this and other Programs

HSB-18 R&D Project

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings & Neighborhoods

HSB-03 Smart Buildings

HSB-06 Evidence-based Design 1

Learning Content

- Introduction into Evidence-based Design
- Different aspects of Evidence-based Design concerning health, tourism and office buildings, considering different climate zones
- Economic consequences of Evidence-based Design
- Building Certification Systems - selected credits
- Designing a health or tourism building for a region with a different climate to the one in the students' region of origin

Teaching Methods

Seminaristic teaching / Module Assignment: Portfolio Development & Presentaion + coaching / group work / tutorials / homework / Case studies / Lab-work & LivingLab

Remarks

Excursion to landmark project

Recommended Literature

Different building types

- Hamilton Kirk D.; Watkins, David H. (2009) *Evidence-Based Design for Multiple Building Types: Applied Research-based Knowledge for Multiple Building Types*. USA: Wiley

Healthcare buildings

- Hamilton Kirk D.; McCuskey Shepley, M. (2009) *Design for Critical Care – An Evidence-based approach*. USA: Routledge
- Guenter, R., Vittori, G. (2013) *Sustainable Healthcare Architecture*. 2nd Edition. USA: Wiley

Tourism Infrastructure

- Epler Wood, M. (2017) *Sustainable Tourism on a Finite Planet*. USA : Routledge
- Le Fort, C. (2019) Bon Voyage: Boutique Hotels for the Conscious Traveler. Berlin/Germany : Gestalten

Certifications systems

- USGBC (2019) LEED BD+C: Healthcare
- USGBC (2019) LEED BD+C: Hospitality
- USGBC (2019) LEED BD+C: New Construction

HSB-14 REFURBISHMENT AND RENOVATION

Module code	HSB-14
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-14 Refurbishment and Renovation
Lecturer	Dr. Barbara Uherek-Bardecka
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Research paper
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

Most buildings already exist – in Germany only around 1% of the building stock consists of new buildings of the same year. Furthermore, most older buildings do not comply with current comfort standards, energy regulations and are often far away from sustainability. Therefore, refurbishment and renovation are a major field of activities in the area of healthy and sustainable buildings.

Students learn the concept of Refurbishment and Renovation for different areas and climate zones and are able to apply this knowledge in practice.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the concepts of sustainable and healthy Refurbishment and Renovation, taking into consideration different climate zones and regional, national and international building materials
- Know where and how to find latest relevant knowledge, including research results, in the area of Refurbishment and Renovation.

- Understand the connection between design decisions, health, productivity and investment costs in the focus area.
- Know of GB and HB certification systems with focus on refurbishment and renovation

Skills

Upon completion of the module the students will be able to:

- Analyse and structure the needs of clients
- Analyse and define the adequate team composition with necessary experts
- Communicate adequately with experts of fields of related knowledge
- Structure Refurbishment and Renovation projects, considering all relevant aspects of sustainability and health in buildings and neighbourhoods
- Follow the guidelines of selected building certification systems for sustainable and healthy refurbishment and renovation and prepare the documentation of selected credits
- Develop sustainable and healthy refurbishment and renovation projects

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities.

Methodological competence:

The students improve their knowledge in the field of refurbishment and renovation for different building types and are able to evaluate different design options for specific climatic conditions. With the newly acquired knowledge they are able to improve design solutions, taking into consideration the effects on tenant's health, productivity and well-being.

Furthermore, the students are able to evaluate and improve solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-18 R&D project

HSB-19 Master's Project

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings & Neighborhoods

HSB-03 Smart Buildings

Learning Content

- Introduction into Refurbishment and Renovation
- Analysis of existing buildings - step by step towards Refurbishment and Renovation
- Different aspects of Refurbishment and Renovation concerning different buildings types and different climate zones
  - Usage concepts
  - Materials
  - Technologies
- Economic and financial aspects of Refurbishment and Renovation
- Building Certification Systems for Refurbishment and Renovation Projects

Teaching Methods

Seminaristic teaching / Design Project / tutorials / homework / Case studies / Project Design / Lab-work

Remarks

Excursion to landmark project

Recommended Literature

- USGBC (2019) *LEED BD+C: Core and Shell*. USA:USGBC
- USGBC (2019) *LEED BD+C: Schools.* USA:USGBC
- USGBC (2019) *LEED BD+C: Retail.* USA:USGBC
- USGBC (2019) *LEED BD+C: Healthcare.* USA:USGBC
- USGBC (2019) *LEED BD+C: Hospitality*. USA:USGBC

HSB-15 EVIDENCE BASED DESIGN - CONSOLIDATION

Module code	HSB-15
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-15 Evidence Based Design - Consolidation
Lecturer	Prof. Dr. Michael Laar Prof. Dr. Matthias Huber Prof. Dr. Sascha Kreiskott Prof.Dr.-Ing. Tobias Bader Dr. Neveen Soliman NN
Semester	3
Duration of the module	1 semester
Module frequency	yearly
Course type	required selective course (FWP)
Niveau	Postgraduate - MEng
Semester periods per week (SWS)	6
ECTS	5
Workload	Time of attendance: 30 hours self-study: 120 hours Total: 150 hours
Type of Examination	ModA (incl. Presentation 15 min.)
Weight	5/120
Language of Instruction	English

Module Objective

Students deepen their understanding of five modules of the second semester: Evidence-based Design 1, Ambient Assisted Living & Working, Sustainable Energy Supply Systems, Building Performance Simulations and Green Building Certifications. Based on the results of Evidence-based Design 1 from the previous semester, the project will be improved, concerning the integration into the urban pattern, the building layout concerning implementation, function, quality of spaces, design aspects, environmental, social, economic and cultural aspects. It will be also based on building performance simulations and lead by green building certification systems. Building performance simulations and green building certification systems will be applied in detail. Additionally, the sustainable energy supply systems aspect will be integrated into the project, as well as life-cycle-assessment and a (limited) life-cycle-cost-assessment. The focus will be on coaching, supported by lectures, group work and Lab-work.

Professional competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the synergies of integrated design process.
- Know where and how to find latest relevant knowledge, including research results, in all attended areas in detail.
- Understand the connection between design decisions, health, productivity, and investment costs in detail.
- Know the process of life-cycle-assessment and life-cycle-cost-assessment and its implications and different scenarios.
- Understand in detail the role of different stakeholders in the planning process of sustainable buildings and neighborhoods.

Skills

Upon completion of the module the students will be able to:

o Analyse the specific needs of the client

o Analyse the necessary fields of competence and decide which further experts have to be invited to the design team.

o Organize relevant information concerning specific building type design concepts, regulations and recommendations.

o Apply relevant knowledge in the design of residential and school buildings.

o Evaluate different design options concerning health, productivity and investment costs, as well as operation & maintenance costs.

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Presenting their project, they learn how to address clients and enhance their social communication skills.

Methodological competence:

The students improve their knowledge in the field of Evidence-based Design in the area of residential buildings and schools and are able to evaluate different design option. With the newly acquired knowledge they are able to pre-select design solutions, taking into consideration the effects on tenant's health, productivity and well-being.
Furthermore, the students are able to evaluate and decide upon preliminary solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings & Neighborhoods

HSB-03 Smart Buildings

HSB-06 Evidence-based Design 1

HSB-07 Standards & Green Building Certification Systems

HSB-08 Building Performance Simulations

HSB-10 Ambient Assisted Living & Working

Learning Content

o Consolidation of Evidence-based Design concepts

o Integration of fields of knowledge from the modules Evidence-based Design 1, Sustainable Energy Suppy Systems, Building Performance Simulations and Standards & Green Building Certification Systems.

o Life-cycle-assessment in detail

o Life-cycle-cost-assessment

o Economic consequences of Evidence-based Design

o Planning in detail of a school building under specific conditions of the students' region of origin or any other chosen location

Teaching Methods

Seminaristic teaching / Module Assigment: Portfolio Development + Presentation + Coaching / tutorials / homework / Case studies / Lab-work

Remarks

Excursion to landmark project

Recommended Literature

Architectural Design Basics

Neufert, E. (2019) *Architects? Data.* 5th Edition. Hoboken, NJ, USA: Wiley Blackwell

Different buildings types

o Hamilton Kirk D.; Watkins, David H. (2009) Evidence-Based Design for Multiple Building Types: Applied Research-based Knowledge for Multiple Building Types. USA: Wiley

Residential buildings

o Magwood, C. (2017) Essential Sustainable Home Design: A Complete Guide to Goals, Options, and the Design Process. New Society Publishers

School buildings

o Clipson CW, Johnson RE (1987). Integrated approaches to facilities planning and assessment. Planning for Higher Education. 15 (3): 12?22

o Sheninger, E., Murray, T. (2017) Learning Transformed: 8 Keys to Designing Tomorrow's Schools, Today. ASCD

o Gelfand, L., Freed, E.C. (2010) Sustainable School Architecture: Design for Elementary and Secondary Schools. USA:Wiley

o USGBC (2019) LEED BD+C: Schools.v4. USA: USGBC

HSB-16 HEALTHY & SUSTAINABLE BUILDINGS & NEIGHBORHOODS – SELECTED CHAPTERS

Module code	HSB-16
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-16 Healthy and Sustainable Buildings – selected chapters
Lecturer	Prof. Dr. Michael Laar Prof. Dr. Katerina Volchek (Tourism) Prof. Dr.med. Georgi Chaltikyan (Heath Infrastructure) Prof. Dr. Horst Kunhardt (Health Infrastructure & Digitalization) NN (to be decided according to selected topics)
Semester	2
Duration of the module	1 semester
Module frequency	yearly
Course type	required selective course (FWP)
Niveau	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Oral exam. 25 min.
Weight	5/120
Language of Instruction	English

Module Objective

This module is a so-called "free compulsory elective module" within the Master programme. It provides maximum flexibility for the consolidation of chapters of previous modules and/or for the introduction of additional fields of knowledge, e.g. latest developments. The exact content of this module will be defined at the end of the previous semester. Detailled information about the course topic and contents in the next semester will be published on website and made available for students.

This module can also attend different topics in parallel, forming different groups with different lecturers. This includes the option for common lectures with the Master in International Tourism Development and Master in Medical Informatics.

Furthermore, it opens the opportunity to involve students in ongoing research projects.

The module counts with keynote lectures from internal and external professionals of the selected areas.

Professional competence

Knowledge

- Depends on the selected chapters.

Skills

- Depends on the selected chapters.

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities. They communicate adequately with different stakeholder and experts.

Methodological competence

- Depends on the selected chapters.

Applicability in this and other Programs

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-2 Sustainable Buildings & Neighbourhoods

HSB-3 Smart Buildings

Learning Content

- Depends on the selected chapters.

Teaching Methods

Seminaristic teaching / group work / homework / Case studies / Lab-work / presentations

Recommended Literature

o Depends on the selected chapters.

HSB-17 SMART INFRASTRUCTURE & ARTIFICIAL INTELLIGENCE

Module code	HSB-17
Module coordination	Prof. Dr. Matthias Huber
Course number and name	HSB-17 Smart Infrastructure & Artificial Intelligence
Lecturer	Prof. Dr. Matthias Huber
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required selective course (FWP)
Level	Postgraduate - MEng
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min. (0.8) and oral presentation (0.2)
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

This module is a so-called "free compulsory elective module" within the master programme. Smart Infrastructure is an important and novel concept to reduce consumption and increase efficiency, while maintaining or even improving the quality of living. Artificial intelligence and/or machine learning is starting to change our world – it can be a powerful tool to foster sustainability and enhance building comfort. Smart Buildings and Infrastructures will allow for the efficient integration of new forms of energy and new transportation concepts. Students learn the concept of Smart Infrastructure and Artificial Intelligence and are able to use the newly acquired knowledge in the development of projects with this specific focus.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand the basic concepts of Smart Infrastructure and Artificial Intelligence.

- Understand the potential and challenges of Smart Infrastructure and Artificial Intelligence.
- Know where and how to find latest relevant knowledge, including research results
- Understand the connection between design decisions concerning Smart Infrastructure and Artificial Intelligence, health, productivity, sustainability, and investment costs in building and neighbourhood projects.
- Understand the importance that data play in the field of Smart Infrastructure and Artificial Intelligence
- Understand basic ideas of major machine learning algorithms and how they can be applied in the Smart Infrastructure and building context
- Understand important aspects of future energy and traffic systems
- Understand the economics of infrastructure for buildings, villages, and cities

Skills

Upon completion of the module the students will be able to:

- Analyse the potential of using Smart Infrastructure in building and neighbourhood projects and communicate efficiently with further building and urban planning experts
- Analyse the potential of using Artificial Intelligence in building and neighbourhood projects and communicate efficiently with further building and urban planning experts
- Evaluate different options of using Smart Infrastructure and AI concerning health, productivity and investment costs, as well as operation & maintenance costs in buildings and neighbourhoods
- Develop/evaluate design concepts integrating Smart Infrastructure concepts
- Work with data and perform basic data analytic tasks

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities.

Methodological competence:

The students improve their knowledge in the field of Smart Infrastructure and Artificial Intelligence and are able to evaluate different options for specific climatic and socioeconomic conditions. With the newly acquired knowledge they are able to

preselect concepts, taking into consideration the effects on tenant's health, productivity and well-being.

Furthermore, the students are able to evaluate and decide upon preliminary solutions concerning investment costs, as well as operation & maintenance costs.

Applicability in this and other Programs

HSB-18 R&D project

HSB-19 Master's Thesis

Entrance Requirements

Recommended:

HSB-02 Sustainable Buildings & Neighborhoods

HSB-03 Smart Buildings

Learning Content

- Introduction into Smart Infrastructure & Artificial Intelligence
- Introduction to future energy systems
- Grid edge – decentralized energy production
- Smart Buildings as active parts in distribution grids
- District heating and innovative cooling concepts
- Sector coupling and urban energy systems
- Smart traffic concepts
- History and examples of smart city planning
- BIM & Digital Twins
- Smart grids
- Internet of Things IoT
- Smart cities and smart villages
- Decentralized living & working
- Artificial intelligence x Machine learning
- Data handling and analysis

- Data visualization

Teaching Methods

Seminaristic teaching / Group work / tutorials / homework / Case studies / Lab-work

Recommended Literature

- Boyle, G. ed. (2012): "Renewable energy: power for a sustainable future". Oxford University Press, 3rd Edition
- Cengel, Y., Boles, M. (2012): *Thermodynamics: An Engineering Approach*. McGraw Hill Education, 9th Edition
- Quaschning, V. (2019) *Renewable Energy and Climate Change*. 2nd Edition
- John Wiley & Sons, Incorporated
- Siemens, Oxford University, TU Berlin (2019). *The Grid Edge revolution. Innovative drivers towards zero-net-energy*. Switzerland
- https://new.siemens.com/uk/en/company/topic-areas/sustainable-energy/keele.html
- https://new.siemens.com/global/en/products/buildings/references/syracuse.html
- Oliver Theobald (2017): *Machine Learning for Absolute Beginners*
- Oliver Gassmann (2019): *Smart Cities: Introducing Digital Innovation to Cities*

HSB-18 R&D PROJECT

Module code	HSB-18
Module coordination	Prof. Dr. Matthias Huber
Course number and name	HSB-18 R&D Project
Lecturer	Prof. Dr. Matthias Huber
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required selective course (FWP)
Level	Postgraduate - MEng
Semester periods per week (SWS)	6
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written student research project (0.7), presentation (0.3)
Weight	5/120
Language of Instruction	English

Module Objective

Module Objective

This module is a so-called "free compulsory elective module" within the master programme. The objective of this module is to develop a basic understanding of Research and Development as part of the innovation process in the building and smart infrastructure sector.

The objective of this module is to create the connection of research relevant content of module HSB-4 "Advanced Quantitative and Qualitative Research Methods" with "Development", specifically the innovation processes in the building industry. The innovation process itself includes strategy, technology management, road mapping, idea generation and selection, creation of business cases, product development process, market launch, product maintenance, project management and agile methods. Design thinking will be introduced as important method for innovative product development. The students will undergo the entire process of design thinking with their own innovation projects.

Professional Competence

Knowledge

After successfully finishing the module, students will get to:

- Understand methods of all mentioned fields of the innovation process independently
- Understand in how to design the innovation process in all of the above-mentioned aspects
- Understand the design thinking methods as important tool for innovation

Skills

Upon completion of the module the students will be able to:

- Apply methods of all mentioned fields of the innovation process independently and transfer them to new problem areas
- Design the innovation process in all of the above-mentioned aspects and to adapt it to the requirements of the company

Social competence

Students are demonstrating working individually or in small groups to solve problems that aims at enhancing their team-working skills as well as their problem-solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities. The project work can eventually be carried out in cooperation with students from Bachelor Industrial Engineering.

Methodological competence:

The students improve their knowledge in the field of Research and Development in the building sector and are able to set up, organize and carry out small R&D projects. With the newly acquired knowledge they are able to communicate efficiently with R&D specialists of different areas of engineering and social sciences.

Applicability in this and other Programs

HSB-19 Master's thesis

Entrance Requirements

Recommended:

HSB-01 Environmental Psychology

HSB-02 Sustainable Buildings

HSB-03 Smart Buildings

HSB-04 Advanced Quantitative and Qualitative Research Methods

HSB-05 Environmental Hygiene and Medicine

HSB-06 Evidence-based Design 1

HSB-07 Standards & Green Building Certification Systems

Learning Content

- Strategy process, Vision, Mission, Hoshin Kanri
- Product portfolios
- Road mapping, integrated Roadmaps
- Creativity techniques
- Idea management, Evaluation systems
- Product development process
- Design Thinking
- Agile development methods, SCRUM
- Lean Management with focus on Research & Development (R&E)
- Project management
- Organisation structures, Organisation of R&D setup
- Product management
- Development and presentation of Business plans

Teaching Methods

Seminaristic teaching / tutorials / homework / Case studies / Research Project

Recommended Literature

Script

Stanford d.school: https://dschool.stanford.edu/

Joe Tidd (2014): *Strategic Innovation Management*

HSB-19 MASTER´S THESIS INCL. PRESENTATION

Module code	HSB-19
Module coordination	Prof. Dr. Michael Laar
Course number and name	HSB-19 Master´s Thesis incl. Presentation
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate - MEng
Semester periods per week (SWS)	0
ECTS	30
Workload	Time of attendance: 0 hours self-study: 900 hours Total: 900 hours
Type of Examination	master thesis, presentation 15 - 45 min.
Weight	30/120
Language of Instruction	English

Module Objective

The master's thesis is intended to enable independent scientific work in a subject in architecture, civil or environmental engineering, with focus on HSB. The accompanying presentation should promote the ability to appropriately work up and present technical topics in an understandable manner. The master's thesis is intended to determine whether the students have acquired the thorough specialist knowledge necessary for the transition to work, have an overview of the interrelationship between the subject and have the ability to work on problems in the in-depth subject area with scientific methods and to apply scientific knowledge.

The master's thesis is intended to show that the candidate is capable of independently completing a practical task in its technical details as well as in interdisciplinary contexts according to scientific and practical aspects within a specified period.

The approximately 30-minute colloquium (presentation and questioning) serves to determine whether the candidate is able to verbally present the essential basics, relationships and results of the master's thesis, to justify independently and to assess their importance for practice; the use of presentation aids is expressly encouraged.

o Applications of scientific methods

o Scientific documentation

o Interdisciplinary work

o Interface competence

Applicability in this and other Programs

not applicable

Entrance Requirements

Minimum of 80 ECTS

Learning Content

to be defined by student

Teaching Methods

Periodic orientation

Recommended Literature

to be defined by student