HSLU Lucerne University of Applied Sciences and Arts

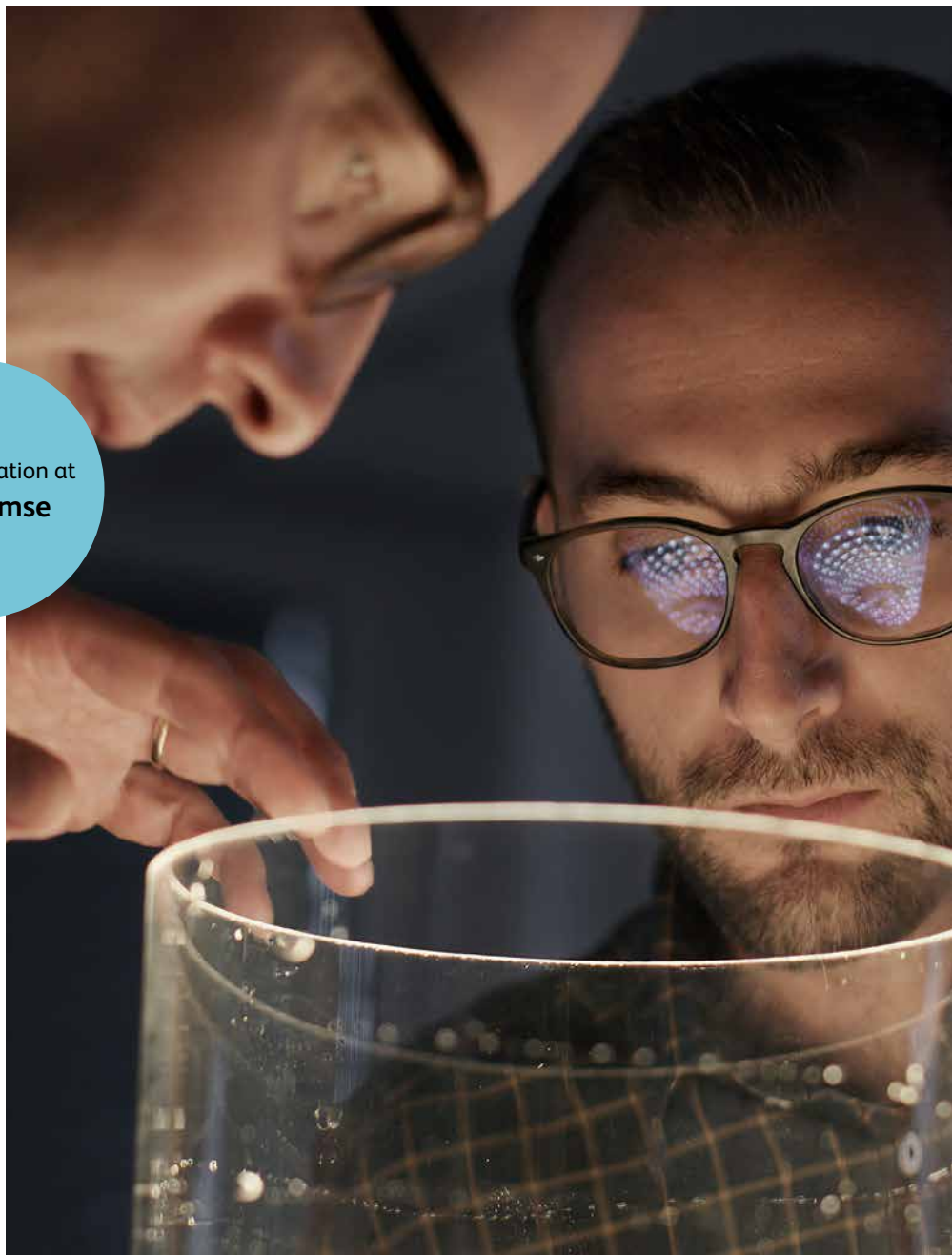
Engineering and Architecture

Overview Lectures Master of Science in Engineering MSE

Academic Year 2024–2025

swissuniversities

More information at
hslu.ch/mse



FH Zentralschweiz


Hochschule Luzern
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Study in the heart of Switzerland

The Master of Science in Engineering MSE at the Lucerne School of Engineering and Architecture

Lucerne, a world-famous center of culture and tourism, is also a center of education. It is home to the Lucerne University of Applied Sciences and Arts, which includes the following schools: School of Engineering and Architecture, School of Business, School of Information Technology, School of Social Work, School of Art and Design, and School of Music.

The School of Engineering and Architecture offers degree programs in the fields of architecture and interior design, building technology, civil and structural engineering, as well as business, energy and environmental systems, digital, electrical, mechanical and medical engineering. The school focuses on extensive interdisciplinary research and group work in the unique areas of: “Building as a System” and “Energy Solutions”.

You can expect state-of-the-art infrastructure, a stimulating interdisciplinary environment, and an exceptional faculty. Over 1,800 undergraduates and graduates as well as almost 1,000 individuals in professional development programs benefit from the outstanding facilities provided on this attractive campus situated at the foot of Mount Pilatus, along the shores of Lake Lucerne.

With its applied research, the Lucerne School of Engineering and Architecture supports society’s development towards sufficiency. Studying for a Master of Science in Engineering (MSE), you will actively contribute to this development in one of eleven profiles.

Business Engineering (BE)

Building Technologies (BT)

Civil Engineering (CE)

Computer Science (CS)

Data Science (DS)

Electrical Engineering (EIE)

Energy and Environment (EnEn)

Mechatronics and Automation (MA)

Mechanical Engineering (ME)

Medical Engineering (Med)

Photonics and Laser Engineering (Pho)

Lectures are primarily held in Zurich near the Main Station. The language of instruction is English, except for the modules in the Civil Engineering specialization, which are taught in German. The project modules are taking place on our campus in Horw or in the premises of our industry and business partners. They are carried out in English or German, as agreed upon with the advisor.

An overview of all lectures that are offered in English including a short description can be found in this brochure.

2024–2025 Academic Year

Fall term 2024

Modules		Priority for profile (3 ECTS for each lecture module)										
		BE	BT	CE	CS	DS	EIE	EnEn	MA	ME	Med	Pho
CM_ComplPro_A	Management of Complex Processes		I		III		I	I	I	I		III
CM_Entrepr	Corporate Management and Entrepreneurship			I	I							
CM_Ethics	Ethics and Corporate Responsibility			I		III					III	
CM_InnChang_A	Innovation and Changemanagement	III	III					III	III	III		
CM_SmartSer	Smart Services	I				I						
CM_TechMgmt	Technology Management	I					I					I
FTP_Alg	Algorithms				III	I						
FTP_AppStat_A	Applied Statistics and Data Analysis		I	I						III	I	
FTP_CryptCod	Cryptography and Coding Theory				I							
FTP_EnviPlan	Raumplanungs-, Bau- und Umweltrecht		I									
FTP_MachLe_A	Machine Learning						II				I	
FTP_ModSim	Modelling Simulation and Optimisation	I										
FTP_Optimiz_A	Optimization	II				III		III	I	I		III
FTP_OrdDiff	Ordinary Differential Equations and Dynamical Systems			III					I	I		
FTP_PartDiff	Partial Differential Equations in Engineering Applications			I				I				I
FTP_PredMod_A	Predictive Modelling	II				I						
TSM_AdvContr	Advanced Control						I					
TSM_AdvDeLearn	Advanced Topics in Deep Learning					I						
TSM_AdvPrPa	Advanced Programming Paradigms				I							
TSM_AdvRobot	Advanced Robotics								I			
TSM_AdvTherm	Advanced Thermodynamics							I				
TSM_AppMNT	Applied Micro and Nano Technologies									I		
TSM_BauStat	Baustatik			I								
TSM_BayMachLe	Bayesian Machine Learning					I						
TSM_Build	Zustandserfassung von Bauwerken			I								
TSM_BusAn	Business Analytics	I										
TSM_CFD	Computational Fluid Dynamics (CFD)							I		I		
TSM_CompVis	Machine Learning in Computer Vision				I							
TSM_DigHealth	Digital Health Systems										I	
TSM_EmbHardw	Design of Embedded Hardware and Firmware						I					
TSM_EmbReal	Embedded Real-time Software						I					
TSM_Heat	Heat Transfer		I									
TSM_InnoDes	Novel Innovation and Design Principles	I										
TSM_Logistic	International Logistics	I										
TSM_ManTech	Manufacturing Technologies									I		
TSM_MedDMA	Medical Device Market Access										I	

Modules		Priority for profile (3 ECTS for each lecture module)										
		BE	BT	CE	CS	DS	EIE	EnEn	MA	ME	Med	Pho
TSM_MobCom	Mobile Computing				I							
TSM_OpEngMe	Optical Engineering and Metrology											I
TSM_OpMgmt	Service Operations and Management	I										
TSM_PhotoStor	Photovoltaic and Storage							I				
TSM_PowElSys	Power Electronics Systems						I	I				
TSM_PredContr	Model Predictive Control								I			
TSM_ServMan	Servitization of Manufacturing	I										
TSM_SignProc	Signal Processing and Transmission						I					
TSM_SmartSys	Smart Systems for Buildings		I									
TSM_SoftwEng	Software Engineering and Architectures				I							
TSM_ThinFilm	Advanced Thin Film Technology											I
TSM_WWTreat	Environmental Technologies: Wastewater Treatment							I				

Modules		ECTS for										
TA.MSEFV_VM1	Specialization Project 1	12	12	12	12	12	12	12	12	12	12	12
TA.MSEFV_VM2	Specialization Project 2	18	18	18	18	18	18	18	18	18	18	18
TA.MSEFV_THESIS	Master Thesis	30	30	30	30	30	30	30	30	30	30	30

The lecture modules in the Master of Science in Engineering are divided into the following three categories:

FTP = Fundamental Theoretical Principles (held on site at Zurich with passive streaming)
TSM = Technical Scientific Specialization (held on site at Zurich with passive streaming)
CM = Context Modules (held online only)

Priority I = Recommendation of profile
Priority II = Recommendation of profile, multiple execution outside of profile lecture days
Priority III = Additional recommendation of profile

Each lecture module is worth 3 ECTS. The Specialization Project 1, the Specialization Project 2 and the Master Thesis are individual project modules individually supervised by one of our professors.

2024–2025 Academic Year

Spring term 2025

Modules		Priority for profile (3 ECTS for each lecture module)										
		BE	BT	CE	CS	DS	ElE	EnEn	MA	ME	Med	Pho
CM_AcWritPre	Academic Writing and Presenting						I					I
CM_ComplPro_B	Management of Complex Processes		I		III		I	I	I	I		III
CM_InnChang_B	Innovation and Changemanagement	III	III					III	III	III		
CM_PrivLaw	Privacy and Law			III	I	I						
CM_QRM	Quality and Risk Management								I	I	I	
CM_SustDev	Sustainable Development		I					I			I	
FTP_AppStat_B	Applied Statistics and Data Analysis		II	II						III	II	
FTP_CompAlg	Numerical Analysis and Computer Algebra						I			I		
FTP_DeLearn	Deep Learning					I						
FTP_DigImPro	Digital Image Processing						I		III		I	I
FTP_Energy	Energy: Production, Consumption and Management		I									
FTP_Life	Lifecycle Management of Infrastructures	III		I								
FTP_MachLe_B	Machine Learning						I				II	
FTP_Multiphy	Multiphysics							I	I			
FTP_Optimiz_B	Optimization	I				III		III	II	II		III
FTP_PhyMNS	Physics on Micro and Nano Scale						III				III	I
FTP_PredMod_B	Predictive Modelling	I				II						
FTP_StochMod	Stochastic Modeling		III		I							
FTP_Tensors	Vectors and Tensors in Engineering Physics							I				
FTP_TheoComp	Theoretical Computer Science				I							
TSM_AdvElDes	Advanced Electronic Design						I					
TSM_AdvMech	Advanced Structural Mechanics									I		
TSM_AdvNLP	Advanced Natural Language Processing					I						
TSM_AdvStDaAn	Advanced Statistical Data Analysis					I						
TSM_AppPhot	Applied Photonics											I
TSM_AutMobRoS	Autonomous Mobile Robot Systems								I			
TSM_AutoSys	Automatic Drive Systems								I			
TSM_BioMedEng	Biomedical Engineering										I	
TSM_ClComp	Cloud Computing				I							
TSM_CSM	Computational Structural Mechanics									I		
TSM_DataMgmt	Data Management					I						
TSM_DigInd	Digitalisation in Industry									I		
TSM_EnReTe	Environmental Remediation Technologies: Soil, Groundwater and Atmosphere							I				
TSM_HydMeth	Thermal Hydraulic Methods for Energy Systems in Buildings and Other Applications		I									
TSM_IntAuto	Integrated Automation								I			
TSM_Laser	Laser and Laser Applications											I
TSM_MachLe-Data	Machine Learning and Data in Operation					I						

Modules		Priority for profile (3 ECTS for each lecture module)										
		BE	BT	CE	CS	DS	EIE	EnEn	MA	ME	Med	Pho
TSM_MarkFor	Market Analysis and Forecasting	I										
TSM_MatPla	Werkstoffmechanik und Plastizität in Konstruktion und Geotechnik			I								
TSM_MatSurf	Materials and Surfaces									I		
TSM_MedDD	Medical Diagnostics and Devices										I	
TSM_NatHaz	Naturgefahren			I								
TSM_NumMeth	Numerical Methods for Building Engineering		I									
TSM_PowGrid	Power Grids: Systems and Devices							I				
TSM_ProcInt	Process Integration and Pinch Analysis							I				
TSM_Product	Product Innovation and Product Lifecycle Management	I										
TSM_ProgAlg	Parallel and Distributed Computing				I							
TSM_ QInOpMgmt	Quantitative Methods in Industrial Operations Management	I										
TSM_StatDig	Statistical Digital Signal Processing and Modeling						I					
TSM_StrucEng	Structural Dynamics and Earthquake Engineering			I								
TSM_TwoPhase	Two-phase Flows with Heat and Mass Transport							I				
TSM_UseInf	Advanced User Interfaces				I							
TSM_WireCom	Wireless Communications				I							

Modules		ECTS for										
TA.MSEFV_VM1	Specialization Project 1	12	12	12	12	12	12	12	12	12	12	12
TA.MSEFV_VM2	Specialization Project 2	18	18	18	18	18	18	18	18	18	18	18
TA.MSEFV_THESIS	Master Thesis	30	30	30	30	30	30	30	30	30	30	30

The lecture modules in the Master of Science in Engineering are divided into the following three categories:

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Each lecture module is worth 3 ECTS. The Specialization Project 1, the Specialization Project 2 and the Master Thesis are individual project modules individually supervised by one of our professors.

Short description of the modules

Context Modules

CM_AcWritPre Academic Writing and Presenting
The goal of this module is to help students to further develop their knowledge and skills in academic writing and presenting through the medium of English. Students will learn what it means to write academic texts and to present to an audience in an accurate, appropriate, and convincing manner. The module is divided into a writing and a presenting part. The writing part of the module focuses on key document types students are expected to master in their academic and professional careers. Using examples and engaging students in practical exercises, the writing part particularly highlights the importance of the academic argument, analysing its structure, components and styles. It looks at how arguments can be built into bigger text blocks that form part of academic text types such as abstracts, introductions, analyses, and others.

CM_ComplPro Management of Complex Processes
One of the biggest challenges encountered in management is recognizing opportunities and making use of them while giving consideration to the associated risks. The constantly increasing dynamism and complexity of the environment in which companies and organizations operate is, however, making it difficult to take successful decisions. Multifactorial correlations, non-linearities, feedback effects and time lags make it difficult to correctly predict the impacts of a decision. Students gain insight into the methods and tools employed for decision-making when faced with complex questions. They learn about cause-andeffect diagrams and quantitative simulation models and apply these in case studies.

CM_Entrepr Corporate Management and Entrepreneurship
In this module students are enabled to evaluate business models. They learn the building blocks of a business modell and elements of sustainable management practices. Along the business model, relevant aspects from different fields such as strategy, marketing, finance and organization are relevant.

CM_Ethics Ethics and Corporate Responsibility
In an environment that is changing increasingly quickly, students will be taught the ability to assume social responsibility either as engineers or in management functions in companies. They will develop a profound awareness of the ethical aspects of their actions and for the ecological and social impacts of companies. In their subsequent professional careers, they will thus be better able to judge the consequences of their work for society, to deal with conflicts in these areas, and to contribute to the corporate responsibility strategies of their organisations in a manner appropriate to their positions.

CM_InnChang Innovation and Changemanagement
The module aims to explain the operational planning and management of innovations to students on the basis of an integrated innovation management model, as well as introducing them to the relevant concepts. This will enable students to establish links to various company-internal and company-external interfaces as part of innovation projects and to correctly interpret and influence these. In this module, students will be trained as “innovation managers” in a broad sense.

CM_PrivLaw Privacy and Law
In the Privacy and Law module, students gain an awareness of the threats to privacy in the fast changing digital society and are prompted to reflect on values in the historical and intercultural context. Students acquire an overview (system and reference knowledge) of actual legal aspects that have not been specifically covered in either the vocational baccalaureate or in the Bachelor’s degree course. In the knowledge and information society these are, in particular, the legal aspects privat data protection, copyright, brand rights, patents, forms of collaboration in the digital economy, relevant contracts etc.

CM_QRM Quality and Risk Management
The CM_QRM addresses the most relevant basics in integrated quality and risk management. Theory is applied and specified by examples and case studies. The module concentrates on current standards and best practices on quality and risk management and introduces the most established approaches.

CM_SmartSer Smart Services
Smart Service Design and Engineering – Value Creation: Basics of Smart Service Design (Customer insight, customer journey, value proposition design, use of data insights). Selected topics of Service Science and Service Dominant Logic. Service blueprinting as a relevant step in the service engineering process. Characteristics of Data Services and Data Products. Use of data in the smart service design process and in the services themselves. Smart Data sources. Iterative improvement up to product maturity. Discussion of applications in the industrial and the sector. Discussion of real-life cases.

CM_SustDev Sustainable Development
Sustainable development is essential for many parts of modern society. This module provides an overview of the history of sustainable development, of established concepts, as well as of relevant initiatives and organisations globally and in Switzerland. Further, methodologies and tools are introduced for engineers to contribute to sustainable development on a technical level. Students learn the fields of application of the various methods as well as their strengths and weaknesses. They learn to apply the tools to analyze and improve the ecological performance of products and industrial processes.

CM_TechMgmt Technology Management
The module describes the practical and theoretical framework of Technology Management, and explains the lifecycle and application of technologies and the related tools and activities used in Technology Management applied to practical case studies.

Fundamental Theoretical Principles

FTP_Alg Algorithms
This module introduces students with different categories of advanced algorithms and typical application areas. In the first part of the module, the students will have a sound understanding of data structures and algorithms for efficiently handling either very large, complex or dynamic data sets or combinations thereof. They will be able to evaluate suitable algorithms and to apply them to typical tasks such as efficiently indexing, searching, retrieving, inserting or updating data such as large volumes of hypertext or spatial data.
The students will be familiar with dynamic algorithms used, for example, in artificial intelligence. The second part of the module will present basic techniques for designing algorithms for hard combinatorial optimization problems. The combination of these basic components – problem modeling, problem decomposition, solution building, solution improvement, learning – lead to classical metaheuristics like genetic algorithms, ant colonies or tabu search. The students will be able to design new algorithms for hard combinatorial optimization problems and to apply them.

FTP_AppStat Applied Statistics and Data Analysis
Students are introduced to statistical tools used in the industrial sector, and particularly in process and quality control. In this module, students learn to plan and conduct statistical evaluations independently (must not be combined with FTP_PredMod).

FTP_CompAlg Numerical Analysis and Computer Algebra
After successful studying students are capable to solve selected practical mathematical problems by combining appropriate numerical methods with suitable computer algebra tools. Moreover, students know how to interprete and visualize computational outcomes resulting from numerical algorithms.

FTP_CryptCod Cryptography and Coding Theory
This course provides the mathematical fundamentals of cryptography and coding theory and illustrates them with numerous practical examples.

FTP_DeLearn Deep Learning
Deep Learning is one of the most active subareas of Machine Learning and Artificial Intelligence at the moment. Gartner has placed it at the peak in its 2017 Hype Cycle and the trend is going on. Deep Learning techniques are based on neural networks. They are at the core of a vast range of impressive applications, ranging from image classification, automated image captioning, language translation such as Google Translate, to playing Go and arcade games. This course focuses on the mathematical aspects of neural networks, their implementation (in Python), and their training and usage. Students will learn the fundamental concepts of Deep Learning and develop a good understanding of applicability of Deep Learning for Machine Learning tasks. After completing the course, students will have developed the skills to apply Deep Learning in practical application settings.

FTP_DigImPro Digital Image Processing
The goal of this module is to teach the fundamentals of image processing, while putting emphasis on their mathematical and algorithmic principles. In addition, specific 2D and 3D industrial and biomedical applications will be treated.

FTP_Energy Energy: Production, Consumption and Management
The objective of this course is threefold: We will begin by dealing with the subject of the energy problem using Switzerland as an example. Afterward, we will develop feasible solutions, such as using energy rationally, recovering heat, or applying heat pumps for the use of energy potential at a lower temperature. In addition, we will discuss how to implement measures within the private sector, at an industrial site, or in a municipality. In the course Energy: Production, Consumption, and Management, we will address the necessary theoretical basic principles of energy technology. Using concrete examples, the functionality of various techniques of energy transformation and systems with which energy can be used intelligently and efficiently will be conveyed. This course is aimed particularly at students who have an interest in energy technology and related fields and have recognized the need to seek applicable solutions. The course provides the necessary basic principles for the multifaceted aspects of the topic.

FTP_EnviPlan Raumplanungs-, Bau- und Umweltrecht
Im Modul werden ArchitektInnen, BauingenieurInnen, GeomatikingenieurInnen, RaumplanerInnen, Umweltingenieurinnen und weitere mit Projekten mit öffentlichen Aufgaben konfrontierte Personen die rechtlichen Grundsätze, gesetzlichen Regeln und Ausführungsbestimmungen vermittelt. Sie sollen befähigt werden, ihr Projekt (Neubau, Umbau, Rückbau, Erweiterung, Entwicklungen und Gestaltungen des Lebensraumes, usw.) rechtskonform und verfahrensrechtlich richtig zu realisieren und mit rechtlichen Friktionen umzugehen.

FTP_Life Lifecycle Management of Infrastructures
In today's rapidly evolving world, infrastructure assumes a crucial role in shaping the way societies function and progress. Roads, railways, bridges, energy grids, machines, and digital networks all contribute to the foundation of modern society. Managing the lifecycle of these infrastructures becomes a critical discipline, ensuring their reliability, sustainability, and adaptability over time. Various stakeholders face complex relationships and goals when making decisions related to infrastructure management. This module introduces students to the multifaceted and strategic aspects of planning, building, operating, and maintaining these essential systems. We discuss established models for analyzing construction and maintenance strategies of technical infrastructures, aiming to develop sustainable measures.

FTP_MachLe Machine Learning
Machine learning (ML) emerged out of artificial intelligence and computer science as the academic discipline concerned with "giving computers the ability to learn without being explicitly programmed" (A. Samuel, 1959). Today, it is the methodological driver behind the mega-trend of digitalization. ML experts are highly sought after in industry and academia alike. This course builds upon basic knowledge in math, programming and analytics/statistics as is typically gained in respective undergraduate courses of diverse engineering disciplines. From there, it teaches the foundations of modern machine learning techniques in a way that focuses on practical applicability to real-world problems.

FTP_ModSim Modelling Simulation and Optimisation
Modelling, simulation and optimization are fundamental to solving problems in a number of fields of science, technology and life. Students will learn to design, implement, simulate, and optimize a model of dynamic system. First we will focus on the analysis of how different model structures can generate different behaviours, reproducing growth processes, but also goal seeking and oscillating behaviours. Then we focus on how systems can be analysed, controlled and optimised thanks to systems theory to obtain desired behaviours. Finally, modelling the behaviour of discrete-event systems is considered and techniques for their simulation and optimisation are discussed.

FTP_Multiphy Multiphysics
The module gives students insight into the modeling and simulation of coupled effects (multiphysics). The module provides an overview on the different application fields of multiphysics modeling and simulation in industry. Students learn the methodical procedures that are necessary for successfully solving modeling and simulation problems in the different areas of engineering and physics. The consolidation and deepening of the theoretical knowledge is achieved on the basis of specific problems that are solved with the appropriate methods and programs (MATLAB, Comsol Multiphysics).

FTP_Optimiz Optimization
This course offers an introduction to optimization, emphasizing basic methodologies and underlying mathematical structures. Optimization refers to the application of mathematical models and algorithms to decision making. A large number of quantitative real-world problems can be formulated and solved in this general framework. Applications of optimization comprise, for instance, decision problems in production planning, supply chain management, transportation networks, machine and workforce scheduling, blending of components, telecommunication network design, airline fleet assignment, and revenue management.

FTP_OrdDiff Ordinary Differential Equations and Dynamical Systems
In this module, students learn which class of dynamical phenomena can be described with systems of ordinary differential equations. They learn to recognize the fundamental behavior patterns of these systems and also to develop simulation models for them.

FTP_PartDiff Partial Differential Equations in Engineering Applications
Foundations of the theory of partial differential equations relevant in engineering applications and their numerical solution.

FTP_PhyMNS Physics on Micro and Nano Scale
This module focuses on physical effects and their applications in photonics, electrical engineering, medical engineering and mechanical engineering which become relevant, when technical systems get miniaturized. In the first step of miniaturization – from macro to micro – the principal physics remains unchanged, but the dominant physical effects change due to a changed surface to volume ratio. Surface related effects become dominant. With further miniaturization – from micro to nano – quantum phenomena become dominant and lead to completely new physical concepts. When the typical size of objects is between several nanometers and a few micrometres we can observe a wealth of fascinating effects that today are the basis for applications from advanced sensing to medical applications, ultrasmall mechanical devices, nanophotonics etc.

FTP_PredMod Predictive Modelling
This course will provide an introductory review of the basic concepts of probability and statistics to understand probability distributions and to produce rigorous statistical analysis including estimation, hypothesis testing, and confidence intervals. Students will be introduced to the basic concepts of predictive modelling which by definition is the analysis of current and historical facts to make predictions about future events. Students will learn several techniques that account for many business and engineering applications of predictive modelling. These include regression techniques, time series models, and classification methods. Applicability and limitations of these methods will be illustrated in the light of data sets and analyses using the statistical software R or Python (must not be combined with FTP_AppStat).

FTP_StochMod Stochastic Modeling
The ubiquitous presence of uncertainty and noise in the engineering sciences and the importance of randomized algorithms in computer and data science make it mandatory to understand and quantify random phenomena. To achieve this goal the course will provide a solid review of probability theory and an introduction to the theory of stochastic processes. Special attention is given to applications, including examples from various fields such as communications and vision, signal processing and control, queuing theory or physics of small systems (Brownian motion).

FTP_Tensors Vectors and Tensors in Engineering Physics
The course starts with an overview of classical engineering physics with special emphasis of balance and constitutive equations (i.e., continuity equations and material laws). The basic concepts of vector analysis are applied to electrodynamics, various transport phenomena, mechanical elasticity and piezo-electric effects. The concept of tensors enables the description of important anisotropic effects of solid state physics. These effects are present in crystals as well as in layered material systems, which are more and more used in modern technology. The given overview facilitates the student's understanding and application of numerical simulation methods (e.g., FEA, multiphysics).

FTP_TheoComp Theoretical Computer Science
The aim of this module is to deepen some basic theoretical aspects of computer science. The master students will learn that formal languages and automata are essential concepts to describe different types of problems and computations; Computability/decidability are central to explain that for many problems seem to have an intuitive solution, although they can not be solved by algorithms; Complexity deals with the amount of time required to solve a problem, and there are many very practical problems that can not be solved in reasonable time or space.

Technical Scientific Specialization

TSM_AdvContr Advanced Control
Model-based controller design is a key technology to control systems with complex dynamics. It was the enabling technology for many innovations in the last decade. In this module, the key elements of the development process are addressed: system identification, LQR/LQG-Controller design and controller implementation. Since there is always model uncertainty, the course ends with an introduction to robust controller design using H-Infinity.

TSM_AdvDeLearn Advanced Topics in Deep Learning
The purpose of this module is to enhance students' understanding of deep learning techniques. We will explore significant and current developments in deep learning, including generative models, attention networks, transformers, graph neural networks and other related techniques. Furthermore, we will examine case studies that pertain to language, speech, or visual processing domains.

TSM_AdvElDes Advanced Electronic Design
This Advanced Electronic Design module gives to the students the key elements for the development of high performance electronic systems. These systems are characterized by the presence of sensitive analogue circuits and signals and the presence of complex and high-speed digital ICs (Integrated Circuits).

TSM_AdvMech Advanced Structural Mechanics
This course provides a comprehensible introduction to basic concepts of continuum mechanics, material modelling and failure assessment for metals and polymers. The students learn the fundamentals of tensor algebra and gain comprehensible insight into the governing mechanical and thermo-mechanical concepts of continuum mechanics. On this basis, an overview is given of state of the art material models for metals and polymers to empower students to competently select advanced material models as implemented in modern Finite Element tools. Finally, the lecture provides a clear insight into the microstructural foundations of failure in metals as well as an overview of mechanical assessment methods as applied in engineering practice. The course is accompanied by regular exercises and hands-on workshops in which advanced material models and assessment methods are applied to practical problems.

TSM_AdvNLP Advanced Natural Language Processing
This module enables students to understand the main theoretical concepts that are relevant to text and speech processing, and to design applications which, one the one hand, find, classify or extract information from text or speech, and on the other hand, generate text or speech to summarize or translate language data, or in response to user instructions. The module briefly reviews fundamentals of natural language processing from a data science perspective, with emphasis on methods that support recent approaches based on deep learning models. The module emphasizes the origins and rationale of foundation models, which can be fine-tuned, instructed, or given adequate prompts to achieve a wide range of tasks, thus paving the way towards generative artificial intelligence. The module also provides practical knowledge regarding multi-task models for spoken or written input, multilingual models, and interactive systems, as well as practical skills through hands-on exercises using open-source libraries and models, focusing on the rapid prototyping of solutions for a range of typical problems.

TSM_AdvPrPa Advanced Programming Paradigms
Although widespread, the currently mainstream imperative, object-oriented programming paradigm, with testing as its main method of quality assurance, has its limitations. Even though it allows novices to write programs relatively quickly and without much formal training, such programs tend to become complicated as soon as they need to do something non-trivial. This makes them increasingly hard to write and reason about, making assurance methods that give better guarantees than software testing intractable. Similarly, even though it is possible to write software tests relatively quickly and without much formal training, such tests are only able to show the presence of faults, but never their absence.

TSM_AdvRobot Advanced Robotics
In this module, basic and advanced robotics knowhow is developed necessary for leading-edge, innovative industrial and service applications with robot manipulators.

TSM_AdvStDaAn Advanced Statistical Data Analysis
One of the most used (statistical) models for inferential data analysis is the linear regression model. But it is restricted to a Gaussian distributed response and a linear function for linking the linear combination of predictors with the expected response. Generalized Linear and Additive Models (GLM, GAM) allow us to relax some of these restrictions by specifying a more general set of response distributions and non-linear link functions. Hence we can analyse a wider variety of real world phenomenon such as counts, binary outcomes proportions and amounts (i.e. non-negative real-valued data). The aim of this modelling approach is to better understand the response outcome induced by the predictors based on the available data, allowing for better and more informed interpretation of the phenomenon.

TSM_AdvTherm Advanced Thermodynamics
In Part A this module reviews the subjects of basic engineering thermodynamics (energy, entropy and material balances, fluid properties, and important thermodynamic cycles) and extends knowledge to deal with real fluids, phase and chemical equilibria, system stability, and processes with chemical transformation. Additionally, in Part B the students will learn to draw connections between detailed, thermodynamic formulae and full thermodynamic systems. The basic tools of thermodynamics (balances of conservative quantities) will be employed to model any complex, thermodynamic system. Selected examples will illustrate the utility of applying thermodynamics in various practical fields.

TSM_AppMNT Applied Micro and Nano Technologies
Based on selected examples, this module imparts the scientific and technological basics as well as the possibilities and the perspectives of the micro- and nanotechnologies to the participants. The students will become aware of the enormous potential of applications of this field and acquire a certain ability in handling it.

TSM_AppPhot Applied Photonics
Applied photonics offers an insight into various application areas of photonics, such as optoelectronics, waveguide optics, micro-optics and several application examples. Starting from the basic physics of light matter interaction, the module covers various topics of modern optoelectronics in the field of light detection systems and light sources. After an introduction to the basics of light guiding and the occurrence of fiber modes, loss and dispersion mechanisms in fibers are discussed. The module gives an overview of different types of fibers and shows the importance of single mode fibers, specialty fibers and integrated waveguides for modern photonic applications. Furthermore, microoptical components are introduced to emphasize their advantages for light shaping, beam guidance and fiber coupling. The module is rounded off by a selection of special applications such as optical telecom, fiber measurement and sensor technology, organic electronics, optical biosensors, smart lighting concepts or similar topics.

TSM_AutMobRoS Autonomous Mobile Robot Systems
Mobile robots are complex mechatronic systems often interacting autonomously with their environment. In the first part, the course provides theoretical fundamentals of mobile robot sensor fusion, planning, localization and mapping with examples in ROS. Tests of these complex systems can be conducted in simulated environments to speed up development and minimize risk of damage. Data from live tests can be recorded for later reuse and analysis as a foundation for further development. In the second part of the course, students learn how to develop robot software and put it into practice using a practical example on a training robot. This includes real-time control, path planning, odometry, observers, position estimation, path control, etc. In the development process, we use the same development environments and libraries as in our industrial research projects.

TSM_AutoSys Automatic Drive Systems
This module treats methods of concept, dimensioning and development in the servo drive technology sector which are particularly compatible with the various industries.

TSM_BauStat Baustatik
Ziel des Moduls ist, durch die Erweiterung des im Bachelorstudium angeeigneten Wissens ein vertieftes Verständnis über das Tragverhalten schlanker Stabstrukturen zu erlangen. Im Modul werden verschiedene Tragwirkungen vor allem schlanker und elastischer Stäbe behandelt. Speziellere Beanspruchungen wie Querkraftschub und Torsion, inkl. Wölbkrafttorsion werden vertieft behandelt. Weiterhin wird das Tragverhalten besonderer schlanker Stabkonstruktionen, wie z.B. Seile und Bögen vertieft. Einen grossen Teil wird ausserdem die Stabilitätstheorie einnehmen, in dem mit analytischen und numerischen Methoden Verzweigungsprobleme gelöst und Berechungen nach Theorie II. Ordnung durchgeführt werden.

TSM_BayMachLe Bayesian Machine Learning
Bayesian statistics provides an alternative viewpoint to the classical ‘frequentist’ statistics by using a different, more subjective interpretation of probability. This brings various advantages in solving typical industry problems, such as the inclusion of prior knowledge, more intuitive hypothesis tests or modeling uncertainty given small amounts of data. With increasing computational power, the popularity of Bayesian statistics and machine learning has grown significantly over the past decade. This course provides students with a solid understanding of the fundamental concepts of Bayesian statistics, introduces various computational methods required in Bayesian statistics and Bayesian machine learning, and discusses numerous examples and applications of Bayesian machine learning. Bayesian as well as Gaussian process regression models are introduced and explored, with a particular focus on graphical models and Bayesian networks to model relationships and to infer causality. In addition, advanced topics and their applications are covered, such as Bayesian optimisation, non-parametric mixture models for clustering, and Bayesian neural networks.

TSM_BioMedEng Biomedical Engineering
The lecture encompasses a comprehensive exposition of Biomedical Engineering. It commences with a historical overview, followed by an examination of contemporary methodologies and tools. Physiological principles will be discussed before focusing on subjects like biosignals and sensors. An array of topics will be dissected, including but not limited to bioimaging, biomolecular engineering, tissue engineering, and the intricacies of precision and personalized medicine. Attendees will attain discernment concerning foundational prerequisites such as biology and physiology and the variety of materials used for implants, prostheses, and available biomaterials. Current clinical paradigms will be scrutinized, notably osteoporosis, fracture fixation, and osteoarthritis. Furthermore, orthopedic treatment modalities and osteosynthesis techniques will be meticulously analyzed, encompassing fracture fixation and the primary stability of implants and joint replacements. A deeper comprehension will be given to measurement technologies catering to human physiological performance encompassing kinematics and kinetics. This includes evaluating movement analysis, muscular dynamics, and cerebral activity. The course will also discuss (robot-assistive) rehabilitation technologies in the case of neuropathology, such as stroke, MS, and paraplegia, with a specific focus on innovations in virtual/augmented reality.

TSM_Build Zustandserfassung von Bauwerken
Ein grosser Teil der zukünftigen Bauaufgaben wird an bestehender Bausubstanz durchgeführt werden. Dieses Modul vermittelt dem Masterstudierenden die grundlegenden Methoden und Verfahren zur Erhaltung von Bauwerken. Die Zustandserfassung mit einer fachlich fundierten Beurteilung ist Grundlage jeder Instandsetzung und ggf. Veränderung von Bauwerken und Infrastrukturanlagen. Die Auseinandersetzung mit bestehenden Tragsystemen, das Erkennen von konstruktiven Zusammenhängen sowie die Beurteilung der aktuellen Tragfähigkeit sind Schwerpunkte der Ausbildung. Anhand von Beispielen aus dem Stahlbeton-, Stahl- und Holzbau lernen die Studierenden die Methodik und die Spezialitäten kennen.

TSM_BusAn Business Analytics
Business Analytics (BA) is the science of analyzing enterprise data with statistical methods. The aim is to better understand market, customers, internal processes and the competitive environment, allowing for better and more informed decisions in business. As such, BA goes well beyond simply presenting data, numbers and tables, but focuses on finding new patterns, explaining the occurrence of results and forecasting future development. The essence is to find meaning in the data und successfully deploy it into the daily business life. This course will provide an overview over the principal questions, practices, methods, tools and goals in BA.

TSM_CFD Computational Fluid Dynamics (CFD)
This module provides students with an introduction to CFD by imparting knowledge of state-of-the-art techniques in computational fluid dynamics, with the emphasis on fluid physics and verification/assessment.

TSM_ClComp Cloud Computing
Lecture on advanced topics in the domain of Cloud Computing, more precisely covering use, operations, development of and for IaaS and PaaS, as well as developing applications natively for the cloud.

TSM_CompVis Machine Learning in Computer Vision
Analyzing images is a very complex task that has many important real-world applications. This module presents powerful techniques to extract information from images and 3D data, based on machine learning and deep learning methods. These methods are mostly used as “black boxes” and their inner workings are not discussed in much detail. The module provides an overview of many image analysis applications such as document analysis, medical imaging and autonomous driving; examples of advanced uses of deep learning on images (generative networks for image synthesis, adversarial networks, neural style transfer) are also discussed.

TSM_CSM Computational Structural Mechanics
The module provides students with comprehensive knowledge in the numerical simulation of demanding static and dynamic problems in structural mechanics. Special emphasis is placed on validation methods for the models and verification possibilities for the results.

TSM_DataMgmt Data Management
This course is about Data Engineering and Information Retrieval. It covers methods and technologies for managing, processing and analyzing potentially large and distributed data collections for transactional or analytical use, including multi-model databases and NoSQL stores. And it covers also mastering data in unstructured form (full text search).
The course consists of four parts: 1. Database Management; 2. Data Warehousing and Data Analytics (Business Intelligence); 3. Data Integration including Data Synthesis; and 4. Information Retrieval.

TSM_DigHealth Digital Health Systems
This course provides an in-depth overview of data management in digital healthcare. First, the special features and challenges of medical documentation will be discussed followed by the underlying ontologies, classifications and scoring systems. Particular emphasis will be placed on a deeper understanding of different dimensions of interoperability. This knowledge will be used to address exemplary specific medical information systems. Challenges for software development in the context of the Medical Device Regulation ("MDR") are covered. Digitalization considerations will then open the next section which deals with the particular challenges of digital transformation in healthcare. In particular, the inclusion of patients in future data collection will be discussed and demonstrated, as well as the potential of the merging of lifestyle data, vital data and medical documentation. The topic of data reuse from the different medical applications combined with security issus within the emerging data science centers is also a subject of this module.

TSM_DigInd Digitalisation in Industry
This modules enables the students to contribute to digital transformaion in the industry. They learn about the fundamental concepts,technical and organisational requirements for digital transformation. They will be able to ask the right questions in a conceptual discussion. This module offers an overview of digitization in industry from several perspectives.

TSM_EmbHardw Design of Embedded Hardware and Firmware
This module introduces the student to advanced concepts in modern embedded systems engineering. The module is divided into two sections. The first section is practical/theoretical and is designed to get the student familiar with implementing System on Chip (SoC) designs. The second part discusses formal Hardware/Software Co-Design including design and implementation of advanced embedded architectures as well as the verification and test of the resulting system.

TSM_EmbReal Embedded Real-time Software
Embedded Systems, although they are not visible, have become integral parts of this world. Embedded Systems essentially consist of two components: hardware and software. In contrast to information systems e.g. in the banking world, hardware is more application specific. Due to this fact, the software that interacts directly with the hardware is more specific as well. Real-time and concurrency are important issues in Embedded System development, which come on top of the generally valid requirements for correctness and reliability.

TSM_EnReTe Environmental Remediation Technologies: Soil, Groundwater and Atmosphere
This course will provide the student with the background knowledge useful to address different sources of pollution, of measures and technologies to prevent pollution and of contaminated systems and the available technologies for remediation. General aim is knowing the main factors and processes affecting contaminants distribution in the environment and remediation technologies for soil and groundwater.

TSM_Heat Heat Transfer
The basic theories of heat transfer by conduction, convection and thermal radiation are presented. However, this study-unit focuses on solving practical heat transfer problems in different fields of engineering such as architectural and HVAC engineering, mechanical and process engineering, electrical as well as environmental engineering.

TSM_HydMeth Thermal Hydraulic Methods for Energy Systems in Buildings and Other Applications
The course imparts knowledge on practical design methods for thermal energy systems such as heating and cooling circuits, solar thermal systems, large extensive pipe networks, and heat pump evaporators. Special emphasis is placed on the conditions for safe operation. The design and integration of storage tanks and heat pumps into thermal networks is also covered. Furthermore, building physical aspects and practical rules regarding pipe routing, building integration, and maintenance are discussed as well.

TSM_InnoDes Novel Innovation and Design Principles
In order to keep generating competitive advantage through innovation, both manufacturing and service industries are in need to apply novel innovation and design principles. This module will focus on reuniting the study and practice of entrepreneurship and innovation. It takes a process-oriented view of agile Innovation. First it starts with recognizing the opportunity and understanding the problem space using design thinking and selecting appropriate tools and methods. After achieving the Problem/Solution-Fit with the Lean Start-up approach an MVP is further developed and the using agile product and customer development, business design the venture can be scaled. Alongside this journey, different tools are selected, e.g 5Wh, customer journey, big data Analytics, business ecosystem design canvas, Lean Canvas are applied. Approaches such as Design Thinking, user-driven innovation, lean startup and lean entrepreneurship, corporate venturing, jugaad innovation will be used to work on one real-life business cases. Different excursions complete the module to see how novel design and innovation principles are applied in practice.

TSM_IntAuto Integrated Automation
In an automation system in manufacturing technology or process automation, sensors measure non-electric values and actuators, such as drives, influence the process. The individual components are controlled by control systems and automatic controllers, connected with industrial networks, and supervised by humans. The emphasis of this module is on the selection and determination of the individual components, bearing in mind functional aspects, with special attention to functional safety.

TSM_Laser Laser and Laser Applications
This module provides a broad overview about the fascinating field of state-of-the-art Laser technology and its applications in industry, R&D, medicine and communication. The modul provides a comprehensive insight into the Laser and applications market, Laser types and devices, Beam deliveries, Laser machines, Physics of interaction between laser and material, and real industrial application examples presented by experts with industrial background. Module objective is to increase and enhance the technological competences on laser generation, control, and laser-material interaction.physical/ technological limits and competing technology.

TSM_Logistic International Logistics
The module starting from the analysis of the whole Supply Chain configuration and management process, underlines in particular the greater importance role that logistics and procurement are assuming in modern collaborative Supply Chain. Procurement is a strategic business driver that allows companies to efficiently focus on their key competences and activities while leveraging competences and cost advantage stemming from a complex supplier network, which provides products and services. Logistics activities are crucial for modern Supply Chains, ensuring a smooth sharing of information and materials among manufacturers and their globalized supplier networks. Moreover, distribution logistics plays a crucial role in delivering customer experiences and value, thanks to differentiated options and services. The evolution of Supply Chain activities in reaction to new paradigms, such as sustainability and mass customization, and thanks to technological innovations, such as Industry and SCM 4.0, will be analysed in order to better understand future challenges and opportunities.

TSM_MachLeData Machine Learning and Data in Operation
This module presents powerful techniques to manage the lifecycle of machine learning models, covering in particular baseline models, infrastructure (clusters, cloud, edge AI and resource management) and tooling (frameworks), model training and debugging, model evaluation and tuning, data management (sources, storage, versioning, privacy), systems testing (CI/CD) and explainability, deployment (batch, service, edge), monitoring (data drift) and continual learning. Emphasis is placed on practical tools, real use-case scenarios, and the relevant hardware and software platforms. Additional topics such as business requirements and objectives, project management for ML, team structure, user experience as well as responsible use of ML systems, including sustainable AI, are also considered.

TSM_ManTech Manufacturing Technologies
Selected future-oriented manufacturing technologies and procedures with economic aspects of these technologies. Including the improvement of productivity and quality.

TSM_MarkFor Market Analysis and Forecasting
A proper understanding of the current state and probable future development of a market is key to any successful business development. The module Market Analysis and Forecasting provides the foundations of analysis of complex socio-economic systems. It puts students in place to autonomously plan, design and execute their own qualitative and quantitative analysis. Development of well-founded forecasts and scenarios completes the understanding of customer data, markets and the socio-economic environment. Tools for the definition and the analysis of company reactions to potential future market scenarios will complete the module, allowing for transformation of market inputs into strategic choices.

TSM_MatPla Werkstoffmechanik und Plastizität in Konstruktion und Geotechnik
Inhalte: Einführung in Kontinuum-Mechanik und in Plastizitätstheorie, Analyse der Stoffgesetze für Boden und Baustoffe im Bereich des konstruktiven Ingenieurbaus; Anwendung der Plastizitätstheorie für Traglastberechnungen in der Geotechnik sowie im konstruktiven Ingenieurbau | Ziele: Nach diesem Modul sollen die Studierenden ein vertieftes Verständnis über die Stoffgesetze von Boden sowie von Baustoffen im konstruktiven Ingenieurbau entwickeln und fähig sein, diese Stoffgesetze korrekt in der Berechnung der Traglast für konkrete Bauwerke anzuwenden. Zudem sollen die Studierenen die Methoden für Berechnung des Tragvermögens mittels Plastizitätstheorie in der Geotechnik sowie im konstruktiven Ingenieurbau verstehen und in geeigneten praktischen Aufgaben anwenden können.

TSM_MatSurf Materials and Surfaces
The interdisciplinary field of materials science and engineering covers approaches to improving the synthesis of new materials, to understanding their surfaces and main properties and, in particular, to adapting their properties to meet special requirements. The aim of this course is to teach students the fundamental principles necessary to understand the relationships between structure and property in material development.

TSM_MedDD Medical Diagnostics and Devices
This module gives an introduction to the physical and technical principles and applications of common diagnostic modalities. Starting with an overview of clinically used modalities and their applications, technical requirements and limitations based on the fundamental principles will be discussed. Furthermore, efficient methods for biomedical signal processing and analysis are introduced.

TSM_MedDMA Medical Device Market Access
The course provides an in-depth overview on necessary aspects for implementing a medical device into the market. You will work on real products and improve the device by reviewing the clinical need and update the concept. For this you will be guided through the first steps of the Stanford biodesign principle. Besides concept improvement you will learn how to go through the mandatory regulatory aspects. In addition, you will get insights into market analysis techniques and fundamentals of the health care system.

TSM_MobCom Mobile Computing
This module enables students to develop advanced, native applications for the Android mobile operating system and get a solid understanding of mobile computing concepts. Building on the basics of mobile application development, this course covers a selection of application programming interfaces for on-board sensors and connectivity options for the integration with backend services, IoT platforms and peripheral devices. Lecturers share their experience and best-practices from recent projects involving mobile computing. Students work with both emulators and real devices.

TSM_NatHaz Naturgefahren
Das Modul behandelt die wichtigsten meteorologischen-hydrologischen sowie gravitativen Naturgefahren. Neben der Auseinandersetzung mit einzelnen Gefahren (Entstehung, Gefährdungsbilder, Analysen, Massnahmen) werden auch das integrale Risikomanagement sowie rechtliche Aspekte und Haftungsfragen behandelt.

TSM_NumMeth Numerical Methods for Building Engineering
Description of numerical methods and application in building thermodynamics and heat transfer. Modelling complex heat transfer through building construction and for modelling air movement outside and inside the building. Numerical methods for fire simulations. Modeling and solving practical problems in different fields of building engineering.

TSM_OpEngMe Optical Engineering and Metrology
This module will provide the students with knowledge of numerous engineering and practical aspects of optical components, instruments, and metrology systems. Starting from seemingly simple optical components (mirrors, lenses, gratings, filters), the module covers high tech novelties on how to improve those components and bring them to the new level. Building up on those concepts, we will discuss more complex components, including acousto-optic, electro-optic, and liquid crystal modulators, as well as simpler systems like objectives and spectrometers. The module will be completed with methods applied in industry for measuring and diagnostics of various processes, including industrial interferometry, spectroscopy, imaging, and precise distance measurements.

TSM_OpMgmt Service Operations and Management
In all developed economies, the service sector is the dominant economic sector. Its importance is still growing. In particular new services based on new technologies such as mobile and internet-based technologies are changing our world at a breathtaking pace. The goal of this module is to make students familiar with some of the main concepts of modern services. The module focuses on service science and strategic service management on the one hand, and service operations management (service delivery) on the other hand.

TSM_PhotoStor Photovoltaic and Storage
This course focuses on the advanced understanding of the main components of Photovoltaic PV power generation systems including storage options. The goal goes beyond the competence to design a PV System, like the installer business is used to do, but also to understand how the components are working in detail, either for different PV module technologies as well as for different inverters power electronic topologies ore battery types. Due to the fact, that in Switzerland some employees in the PV sector are not installing any PV system, but working for companies supplying components of turn-key PV module production lines for the world market as well others produce batteries, the main concepts of processes and different concepts of production lines of such components are included in the course Analysis of the economic parameter of state of art PV systems and batteries, together with environmental key factors like energy pay back times will complete this course. Today the numbers of PV systems including a battery system to use PV electricity at night is growing in Switzerland with an increasing trend. The power electronic concepts, energy flows and control strategies in these grid connected PV and storage systems are discussed as well as levelized cost of electricity.

TSM_PowElSys Power Electronics Systems
Building upon the students' fundamental knowledge in power electronics, this module covers current topics in the field of power electronics in greater depth. In the first part, the focus is on modern switched mode power conversion topologies, small signal modelling, control methods and the magnetic components. The second part looks into topologies, modulation schemes and control techniques for medium and high-power converters. One application discussed in greater depth is their application in power grids.

TSM_PowGrid Power Grids: Systems and Devices
In this module, students will increase their knowledge in selected areas of power grids in electricity distribution and transmission: High voltage engineering basics and relevant design rules; Breakdown theory; Generation of AC testing high voltage and partial discharge testing; Design, construction and parameters of components in power grids; Learn the origin of networks failures, consequences, preventing and recovery measures; Operation principles and challenges of power grids; Special actual challenges and trends in transmission and distribution systems.

TSM_PredContr Model Predictive Control
Model Predictive Control (MPC) is an optimisation-based approach to control systems and processes. The general mathematical formulation of MPC allows it to be applied to a broad range of systems and considers system constraints intrinsically. The advances in optimisation methods and available computational power have made MPC a valuable alternative to classical control approaches also for fast dynamic systems. Today, MPC applications can be found from the original chemical process control systems to the control of frequency converters with sampling periods down to a few microseconds. This module focuses on introducing MPC from the theoretical basics to the use of tool kits to support the implementation and generation of working code. As the classical frequency domain control methods are not considered here, this module does not need in-depth knowledge of control systems. A general affinity to mathematics and programming skills are beneficial.

TSM_ProcInt Process Integration and Pinch Analysis
Against the background of rising energy prices, incentive taxes and ecological requirements, increasing importance is being attached to reducing the energy requirements of industry. The key to higher energy efficiency and cost-efficiency in thermal processes is the energy integration of processes with the aid of pinch analysis. This is characterized by a systematic approach which can be applied to establish the best system design and the optimum energy input from the economic viewpoint. From the results of the analysis, it is possible to derive measures for heat recovery and an improved energy supply in the context of strategic planning. In this module, students learn the fundamental methods of the energy integration of processes with the aid of pinch analysis. After completing the module, they are in a position to conduct pinch analyses by themselves for "straightforward" industrial processes and to answer the following questions: how large is the energy requirement if an existing plant were to be fully-optimized? Where is the economic optimum for the investment and energy costs? How can this optimum state be achieved? They can then support industrial companies in sustainable development and in the reduction of CO_2 emissions, since reducing energy requirements goes hand in hand with increasing profitability.

TSM_Product Product Innovation and Product Lifecycle Management
Students become acquainted with the product innovation process and its strategic importance for enterprises. The will learn different processes, methods and tools to develop new products and further optimize them along its full lifecycle. A special focus is on the development of complex systems, an interdisciplinary environment. Current approaches and new tools are discussed in addition to established processes such as Systems-Engineering or VDI2206. To further explain the impact of product development outcome on an enterprise level, course will focus on the information flow across an industrial enterprise. Both, the process level (engineering, sales, manufacturing, purchasing, service) as well as the data level (CAX, PLM, ERP, IoT). The module will be accompanied by a product development project, where students apply the theory "hands-on" on a realistic example throughout the semester.

TSM_ProgAlg Parallel and Distributed Computing
The objective of this module is to provide the student with an introduction to parallel computing and algorithms. Students learn to parallelize systems at three different levels: Shared memory systems, distributed memory systems, and heterogeneous shared memory systems. For all three systems, which can be part of a high-performance cluster, students learn the necessary parallelization techniques and a few classical parallel algorithms. This course includes hands-on work to train students in the application of parallel programming techniques and the programming and analysis of parallel algorithms.

TSM_QInOpMgmt Quantitative Methods in Industrial Operations Management
Operations management is concerned with the design, operation and optimization of the value-adding areas of a company. At the strategic level it includes in particular the design of infrastructure and resources, the dimensioning of capacity and the definition of business processes. At an operational level, it includes ongoing planning and control of operational activities. The aim is to achieve high business performance through clever organization and efficient use of resources. In a first part an overview of the classical themes of Operations Management is given. In a second part selected methods of quantitative Operations Management (see Operations Research) are applied to tasks of important areas (see. contents below) of Operations Management. These tasks will be analyzed and optimized with the help of mathematical models.

TSM_ServMan Servitization of Manufacturing
This module will help students to understand how a manufacturer changes its business model to provide a holistic solution to the customer, helping the customer to improve its competitiveness, rather than just engaging the sale of product. Much of the course is based around the transition from pure products to provide product service systems in basic and advanced forms.

TSM_SignProc Signal Processing and Transmission
The aim of this module is to provide insight into state-of-the-art methods of how to make a signal fit for transmission over a cable or over the air. It starts with some information-theoretic aspects, covers modern modulation formats, hardware used, and closes with an excursion into propagation mechanisms.

TSM_SmartSys Smart Systems for Buildings
This module aims to familiarise students with smart systems that are already, or will soon be, present in buildings. These include building automation and control systems (BACS), smart home, IoT solutions, energy management and building security systems. Students will learn the purpose, functionality and applications of these systems. They will also cover the necessary fundamentals such as components and system architecture, communication technologies and protocols.

TSM_SoftwEng Software Engineering and Architectures
The module provides an in-depth view of selected topics of modern software engineering. These stem from the fields: modern software development processes, software architecture, and the principles of evolution of software systems.

TSM_StatDig Statistical Digital Signal Processing and Modeling
The goal of this module is to introduce the students to the powerful world of statistical digital signal processing. While at the bachelor level digital signal processing is most often taught with deterministic signals, in the real world most interesting signals are stochastic in nature. Hence in more advanced applications, such as prediction or noise removal, the theories presented in this module are essential. The basic digital signal processing, linear algebra and probability theory necessary to understand the module are brushed-up at the beginning. Then stochastic processes are introduced which allows the proper formulation of the optimal filtering and spectral estimation problem later on. After an in-depth treatment of the optimal filtering and estimation problem, adaptive filters are introduced which are a popular choice for many advanced statistical digital signal processing problems.

TSM_StrucEng Structural Dynamics and Earthquake Engineering
Der Modulinhalt ist in zwei Themengebiete, Baudynamik und Erdbebeningenieurwesen, untergliedert. Die Baudynamik beinhaltet: Grundlagen der Kinematik und Kinetik des Massenpunktes; die Modellbildung von dynamischen Systemen und das Aufstellen der Bewegungsdifferentialgleichungen bei Ein- und Mehrmassenschwingern; die Berechnung der Systemantwort infolge dynamischer Einwirkungen; Massnahmen zur Reduzierung von Schwingungen. Im aufbauenden Teil Erdbebeningenieurwesen folgt der erdbebengerechte Entwurf an Beispielen; Duktilität und Ermittlung von Antwortspektren; die Berechnung der Schnittkräfte mit Hilfe dem Ersatzkraft- und dem Antwortspektrenverfahren nach den SIA Tragwerksnormen; Grundlagen der verformungsbasierten Nachweise.

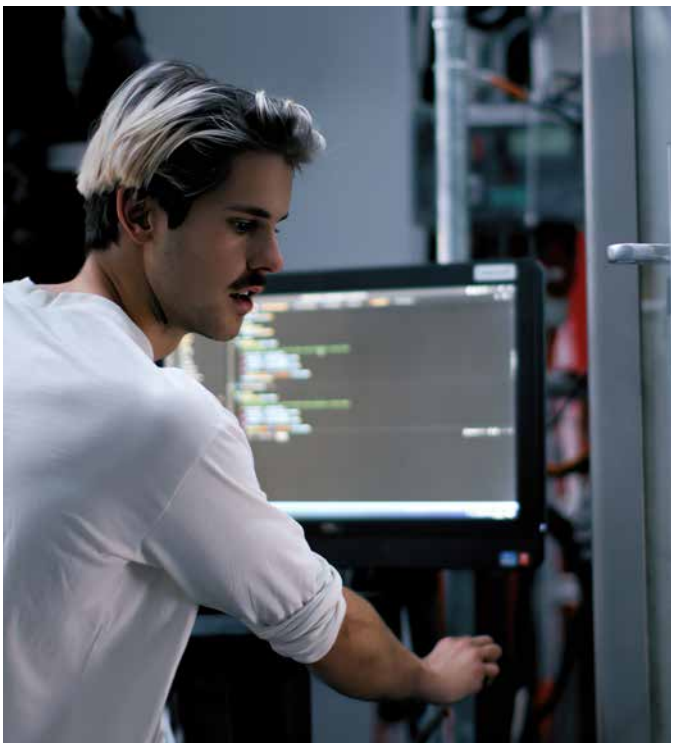
TSM_ThinFilm Advanced Thin Film Technology
The Technology of thin films is a core element in the design and fabrication of photonic components. The objective of the module “Advanced Thin Film Technology” is the introduction to this important technology and to the applications of thin films in the field of photonics with the focus on optical coatings. This includes the design and fabrication of thin films as well as the characterization of their physical properties.

TSM_TwoPhase Two-phase Flows with Heat and Mass Transport
This module deals with transport phenomena at postgraduate level with a focus on technical problems in material, heat and momentum transport, especially in the environment of multiphase flows. Working on the basis of conservation principles, transport equations are derived in a general form. In order to obtain closed solutions for specific problems, the general balance equations are combined with material laws and also with initial and boundary conditions. This then highlights the analogies and relations between transport phenomena in different technical fields. In this way, students expand the knowledge and skills in thermodynamics, fluid dynamics and heat transport that they have acquired during their undergraduate studies and apply them to solving technical problems of practical relevance.

TSM_UseInf Advanced User Interfaces
Graphical User Interfaces have long become standard UIs for computers, and mobile devices have not only adopted these GUIs but augmented them with multi-touch screens, speech in- and output, gesture, handwriting recognition, and several additional sensors. This has fostered innovative ways of user interaction with the information available on these devices that were only been seen in professional environments so far. In the professional environment, the trend has further developed into more and more immersive systems where the user dives more or less entirely into a virtual world to interact with the vast amount of available information efficiently. In these scenarios, true hand tracking is gaining significant momentum vs. glove-based tracking systems. This module gives a solid introduction to the fundamental concepts and techniques of both advanced user interfaces with different input and output channels and interaction modalities, as well as immersive systems with haptic interaction. Insight into developing these advanced user interfaces and immersive systems with hand-tracking interaction will be given through hands-on exercises.

TSM_WireCom Wireless Communications
The module starts with the physical properties of radio propagation, analog and digital modulation and forward error correction. Then the students will be exposed to the functioning and characteristics of a selection of the most important wireless standards at the present time. The focus will be on the physical layer and the medium-access layer. Exercises will be used throughout the course to exemplify the use and application of the module content to examine existing standards for a given problem in the context of the merits and limitations of each technology.

TSM_WWTreat Environmental Technologies: Wastewater Treatment
The student learns the mechanical, chemical and biological processes used for environmental engineering (wastewater treatment). The course covers chemical, physical and biological treatment technologies. Furthermore, the topic of water reuse (greywater) and nutrient recovery is lectured.



Costs of living in Switzerland

Food, accommodation, and clothing can be costly in Switzerland. Nevertheless, your living expenses may vary greatly according to your own circumstances and lifestyle. The following estimates provide a general guideline:

Approximate expenses	CHF per month
Accommodation	550 – 800
Food	310 – 390
Public transportation	70 – 100
Course material	50 – 130
Health and third party liability insurance	90 – 200
Clothing, travelling, entertainment etc.	230 – 380
Total	**1,300 – 2,000**

Accommodations for students in Lucerne

Offerings of the Lucerne University of Applied Sciences and Arts and places from local hosts.

Students are advised to search for accommodation in good time prior to arrival. The city of Lucerne and its suburbs offer various types of accommodation for students.

STUWO.CH
Verein Wohnraum für Studierende

The non-profit association for student housing in Lucerne, called StuWo offers modern and inexpensive rooms. Ads for privately rented accommodation are also published. Some rooms are especially reserved for exchange students. stuwo.ch/en/lucerne/

studentroom.ch

The foundation offers modern housing facilities between Lucerne and the Lucerne School of Engineering and Architecture. studentroom.ch/en

Do you have any questions?
Our Bachelor & Master Secretariat
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Further information about the Master of Science in Engineering

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