HSLU Lucerne University of Applied Sciences and Arts

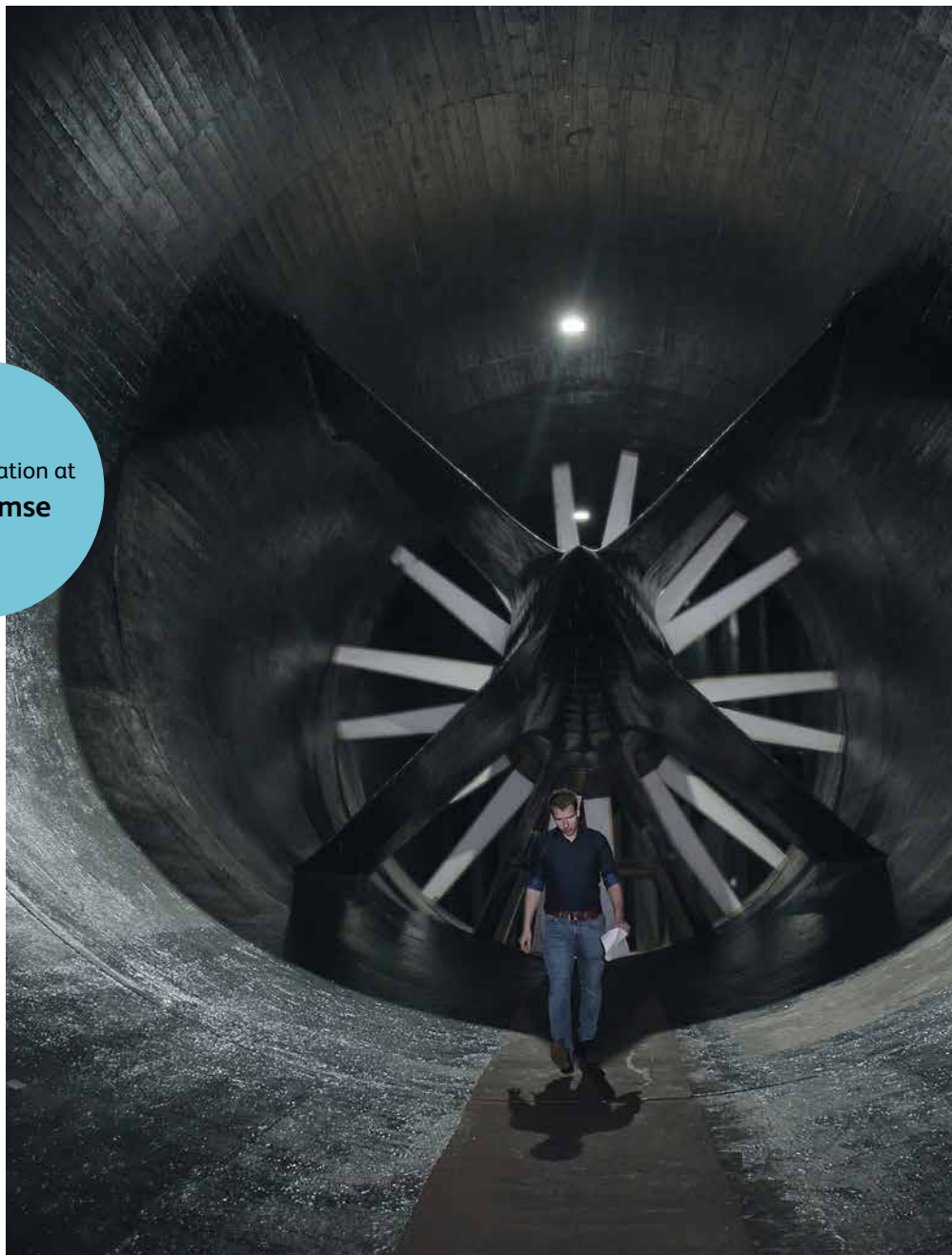
Engineering and Architecture
Information Technology

# Overview lectures Master of Science in Engineering MSE

**Academic Year 2023–2024**

swissuniversities

More information at
**hslu.ch/mse**



FH Zentralschweiz


Hochschule Luzern
Hochschule Luzern
Hochschule Luzern

# 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 systems-, 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 2,000 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.

**Building Technologies (BT)**

**Business Engineering (BE)**

**Civil Engineering (CE)**

**Computer Science (CS)**

**Data Science (DS)**

**Electrical Engineering (EIE)**

**Energy and Environment (EnEn)**

**Mechanical Engineering (ME)**

**Mechatronics and Automation (MA)**

**Medical Engineering (Med)**

**Photonics (Pho)**

Lectures mostly take place in Zurich, directly by the main station. The language of instruction in the lecture modules is English with the exception of the modules in the Civil Engineering profile, 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 in agreement with the advisor.

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

# 2023–2024 Academic Year

## Fall term 2023

| Modules | | ECTS recommended for | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | BT | BE | CE | CS | DS | EE | E&E | ME | M&A | MedE | Pho |
| CM_ComplPro | Complex Processes | 3 | | | 3 | | 3 | 3 | 3 | 3 | | |
| CM_Ethics | Ethics and Corporate Responsibility | | | 3 | | 3 | | | | | 3 | 3 |
| CM_InnChang | Innovation and Change Management | 3 | 3 | | | | | 3 | 3 | 3 | | 3 |
| CM_SmartSer | Smart Services | | 3 | | | 3 | | | | | | |
| CM_TechMgmt | Technology Management | | 3 | | | | 3 | | | | | |
| FTP_Alg | Algorithms | | | | 3 | | | | | | | |
| FTP_AppStat | Applied Statistics and Data Analysis | 3 | 3 | 3 | | | | | 3 | | 3 | 3 |
| FTP_CompAlg | Numerical Analysis and Computer Algebra | | | | | | 3 | | 3 | | | |
| FTP_CryptCod | Cryptography and Coding Theory | | | | | | | | | | | |
| FTP_MachLe | Machine Learning | | | | | 3 | 3 | | | | 3 | |
| FTP_Optimiz | Optimization | | 3 | | 3 | 3 | | 3 | 3 | 3 | 3 | |
| FTP_OrdDiff | Ordinary Differential Equations and Dynamical Systems | | | 3 | | | | | 3 | 3 | | 3 |
| FTP_PartDiff | Partial Differential Equations in Engineering Applications | | | 3 | | | | 3 | | | | |
| FTP_PhyMNS | Physics on Micro and Nano Scale | | | | | | 3 | | | | 3 | 3 |
| FTP_PredMod | Predictive Modelling | | 3 | | | 3 | | | | | | |
| TSM_AdvPrPa | Advanced Programming Paradigms | | | | 3 | | | | | | | |
| TSM_AdvRobot | Advanced Robotics | | | | | | | | | 3 | | |
| TSM_AdvTherm | Advanced Thermodynamics | | | | | | | 3 | | | | |
| TSM_AnSeqDe | Analysis of Sequential Data | | | | | 3 | | | | | | |
| TSM_AppMNT | Applied Micro and Nano Technologies | | | | | | | | 3 | | | |
| TSM_AppPhot | Applied Photonics | | | | | | | | | | | 3 |
| TSM_CompVis | Machine Learning in Computer Vision | | | | | 3 | | | | | | |
| TSM_DigHealth | Digital Health Systems | | | | | | | | | | 3 | |
| TSM_EmbHardw | Design of Embedded Hardware and Firmware | | | | | | 3 | | | | | |
| TSM_EmbReal | Embedded Real-time Software | | | | | | 3 | | | | | |
| TSM_EnReTe | Environmental Remediation Technologies | | | | | | | 3 | | | | |
| TSM_Heat | Heat Transfer | 3 | | | | | | | | | | |
| TSM_ITSec | IT-Security | | | | 3 | | | | | | | |
| TSM_ManTech | Manufacturing Technologies | | | | | | | | 3 | | | |
| TSM_MarkFor | Market Analysis and Forecasting | | 3 | | | | | | | | | |
| TSM_MedDMA | Medical Device Market Access | | | | | | | | | | 3 | |
| TSM_MobCom | Mobile Computing | | | | 3 | | | | | | | |
| TSM_OpEngMe | Optical Engineering and Metrology | | | | | | | | | | | 3 |
| TSM_PowElSys | Power Electronics Systems | | | | | | 3 | 3 | | 3 | | |
| TSM_PowGrid | Power Grids: Systems and Devices | | | | | | | 3 | | | | |
| TSM_PredContr | Model predictive control | | | | | | | | | 3 | | |

| Modules | | ECTS recommended for | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | BT | BE | CE | CS | DS | EE | E&E | ME | M&A | MedE | Pho |
| TSM_ProcInt | Process Integration and Pinch Analysis | | | | | | | 3 | | | | |
| TSM_ServMan | Servitisation of Manufacturing | | 3 | | | | | | | | | |
| TSM_SignProc | Signal Processing and Transmission | | | | | 3 | | | | | | |
| TSM_SmartSys | Smart Systems for Building | 3 | | | | | | | | | | |
| TSM_SoftwEng | Software Engineering and Architectures | | | | 3 | | | | | | | |
| TSM_WWTreat | Environmental Technolgies: Wastewater Treatment | | | | | | | 3 | | | | |
| | | | | | | | | | | | | |
| 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
TSM = Technical Scientific Specialization
CM = Context Modules

The specialization project 1, the specialization project 2 and the Master thesis are individual project modules individually supervised by one of our professors.

# 2023–2024 Academic Year

## Spring term 2024

| Modules | | ECTS recommended for | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | BT | BE | CE | CS | DS | EE | E&E | ME | M&A | MedE | Pho |
| CM_AcWritPre | Academic Writing and Presenting | | | | | | 3 | | | | | 3 |
| CM_ComplPro | Complex Processes | 3 | | | 3 | | 3 | 3 | 3 | 3 | | |
| CM_Entrpr | Corporate Management and Entrepreneurship | | | 3 | 3 | | | | | | | |
| CM_InnChang | Innovation and Change Management | 3 | 3 | | | | | 3 | 3 | 3 | | 3 |
| CM_PrivLaw | Privacy and Law | | | 3 | 3 | 3 | | | | | | |
| CM_QRM | Quality and Risk Management | | | | | | | | 3 | 3 | 3 | |
| CM_SustDev | Sustainable Development | 3 | | | | | | 3 | | | 3 | |
| FTP_AppStat | Applied Statistics and Data Analysis | 3 | 3 | 3 | | | | | 3 | | 3 | 3 |
| FTP_DigImPro | Digital Image | | | | | | 3 | | | 3 | | 3 |
| FTP_Energy | Energy: Production, Consumption and Management | 3 | | | | | | | | | | |
| FTP_Life | Lifecycle Management of Infrastructures | | 3 | 3 | | | | | | | | |
| FTP_MachLe | Machine Learning | | | | | 3 | 3 | | | | 3 | |
| FTP_Multiphy | Multiphysics | | | | | | | 3 | | 3 | | |
| FTP_Optimiz | Optimization | | 3 | | 3 | 3 | | 3 | 3 | 3 | 3 | |
| FTP_PredMod | Predictive Modelling | | 3 | | | 3 | | | | | | |
| FTP_Tensors | Vectors and Tensors in Engineering Physics | | | | | | | 3 | | | | |
| FTP_TheoComp | Theoretical Computer Science | | | | 3 | | | | | | | |
| TSM_AdvContr | Advanced Control | | | | | | 3 | | | | | |
| TSM_AdvElDes | Advanced Electronic Design | | | | | | 3 | | | | | |
| TSM_AdvMech | Advanced Structural Mechanics | | | | | | | | 3 | | | |
| TSM_AnTeDe | Analysis of Text Data | | | | | 3 | | | | | | |
| TSM_AutMobRoS | Autonomous Mobile Robot Systems | | | | | | | | | 3 | | |
| TSM_AutoSys | Automatic Drive Systems | | | | | | | | | 3 | | |
| TSM_BioMedEng | Biomedical Engineering | | | | | | | | | | 3 | |
| TSM_CFD | Computational Fluid Dynamics | | | | | | | 3 | 3 | | | |
| TSM_CSM | Computational Structural Mechanics | | | | | | | | 3 | | | |
| TSM_DataMgmt | Data Management | | | | | 3 | | | | | | |
| TSM_DeLearn | Deep Learning | | | | | 3 | | | | | | |
| TSM_DigInd | Digitalisation in Industry | | | | | | | | 3 | | | |
| TSM_HydMeth | Thermal Hydraulic Methods for Energy Systems in Buildings | 3 | | | | | | | | | | |
| TSM_InnoDes | Novel Innovation and Design Principles | | 3 | | | | | | | | | |
| TSM_IntAuto | Integrated Automation | | | | | | | | | 3 | | |
| TSM_Laser | Laser and Laser Applications | | | | | | | | | | | 3 |
| TSM_Logistic | International Logistics | | 3 | | | | | | | | | |
| TSM_MatSurf | Materials and Surfaces | | | | | | | | 3 | | | |
| TSM_MedDD | Medical Diagnostics and Devices | | | | | | | | | | 3 | |

| Modules | | ECTS recommended for | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | BT | BE | CE | CS | DS | EE | E&E | ME | M&A | MedE | Pho |
| TSM_NumMeth | Numerical Methods for Building Engineering | 3 | | | | | | | | | | |
| TSM_OpMgmt | Service Operations and Management | | 3 | | | | | | | | | |
| TSM_PhotoStor | Photovoltaic and Storage | | | | | | | 3 | | | | |
| TSM_Product | Product Innovation and Product Lifecycle Management | | 3 | | | | | | | | | |
| TSM_ProgAlg | Parallel and Distributed Computing | | | | 3 | | | | | | | |
| TSM_QInOpMgmt | Quantitative Methods in Industrial Operations Management | | 3 | | | | | | | | | |
| TSM_StatDig | Statistical Digital Signal Processing and Modeling | | | | | | 3 | | | | | |
| TSM_ThinFilm | Advanced Thin Film Technology | | | | | | | | | | | 3 |
| TSM_TwoPhase | Two-phase Flows with Heat and Mass Transport | | | | | | | 3 | | | | |
| TSM_UseInf | Advanced User Interfaces | | | | 3 | | | | | | | |
| TSM_WireCom | Wireless Communications | | | | 3 | | | | | | | |
| | | | | | | | | | | | | |
| 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
TSM = Technical Scientific Specialization
CM = Context Modules

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**
Learning what it means to write advanced academic texts and to present them to an audience in an accurate, appropriate and convincing manner. The module is divided into a writing and a speaking part.

**CM_ComplPro**
Insights into the methods and tools employed for decision-making when faced with complex questions. Cause-and-effect diagrams and quantitative simulation models. Application in case studies.

**CM_Entrpr Corporate Management and Entrepreneurship**
Evaluating business models, building blocks of a business model and alements of sustainable management practices. Strategy, marketing, finance and organization.

**CM_Ethics Ethics and Corporate Responsibility**
Developping a profound awareness of the moral and ethical aspects of the actions and also for the ecological and social impacts of companies. Judging the consequences of the work for society, to deal with conflicts in these areas, and to contribute to the Corporate Responsibility philosophy of an organisation.

**CM_InnChang Innovation and Change Management**
Explaining the operational planning and management of innovations on the basis of an integrated innovation management model, as well as introducing the relevant concepts. Establishing links to various company-internal and company-external interfaces as part of innovation projects and to correctly interpret and influence them.

**CM_PrivLaw Privacy and Law**
Awareness of the threats to privacy in the fast changing digital society. Privat data protection, copyright, brand rights, patents, forms of collaboration in the digital economy, relevant contracts.

**CM_QRM Quality and Risk Management**
Holistic quality and risk management, fundamental tools and the best practice in their application, undertaking and reviewing quality assurance, parameters of influence on a quality audit, conditions for ensuring and obtaining a QM-certification, introduction of risk management standards, methods of risk assessment.

**CM_SmartSer Smart Services**
Smart Service Design and Engineering – Value Creation; Smart Business Model Design – Value Capturing; Data Protection, Data Security, Data Ethics.

**CM_SustDev Sustainable Development**
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.

**CM_TechMgmt Technology Management**
Practical and theoretical framework of Technology Management. Lifecycle of technologies and the related methods in Technology Management.

## Fundamental Theoretical Principles

**FTP_Alg Algorithms**
Introducing different categories of advanced algorithms and typical application areas. Understanding of data structures and algorithms for efficiently handling either very large, complex or dynamic data sets or combinations thereof. Indexing, searching, retrieving, inserting or updating data such as large volumes of hypertext or spatial data. Presenting basic techniques for designing algorithms for hard combinatorial optimization problems.

**FTP_AppStat Applied Statistics and Data Analysis**
Planning and evaluation of experiments in an industrial framework, control and improvement of processes through statistics, analysis and interpretation of data using multiple regression, illustration of the methods using case studies of an industrial and scientific environment, presentation of graphical and statistical methods, e.g. classic and robust estimation theories and Monte-Carlo simulations.

**FTP_CompAlg Numerical Analysis and Computer Algebra**
Solving selected practical mathematical problems by combining appropriate numerical methods with suitable computer algebra tools. Knowing how to interprete and visualize computational outcomes resulting from numerical algorithms.

**FTP_CryptCod Cryptography and Coding Theory**
Mathematical fundamentals of cryptography and coding theory. Illustration with practical examples.

**FTP_DigImPro Digital Image**
Introduction to 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**
Dealing with the subject of the energy problem using Switzerland as an example, development of feasible solutions, measurement techniques within the private sector, industrial sites, or municipalities, investigation of different technical systems meeting requirements and respecting energy availability, consideration of economic, ecological and social aspects.

**FTP_Life Lifecycle Management of Infrastructures**
Introducing into basic concepts of lifecycle management of infrastructures with respect to costs vs benefit. Discussion of established cost and benefit models of infrastructures. Introduction of different methods for the assessment of maintenance strategies, and for decision making with respect to construction, preservation, and replacement based on lifecycle cost, reliability, availability, and risk analysis.

**FTP_MachLe Machine Learning**
Machine Learning system design and debugging (how to get intuition into learned models and results) as well as feature engineering; covered algorithms include (amongst others) Support Vector Machines (SVM) and ensemble methods.

**FTP_Multiphy Multiphysics**
Providing an overview on the different applicationn fields of multiphysics modeling and simulation in industry. Methodical procedures for successfully solving modeling and simulation problems in the different areas of engineering and physics. Solving of specific problems with the appropriate methods and programs (MATLAB, Comsol Multiphysics).

**FTP_Optimiz Optimization**
Introduction to optimization, emphasizing basic methodologies and underlying mathematical structures. Application to decision problems in areas like 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**
Classification of problems solvable with ODEs, presentation of analytical and numerical methods for the resolution of ODE systems, analysis of the behavior of dynamical systems in discrete and continuous form, stability analysis of dynamical systems, nonlinear system behavior and introduction to bifurcation phenomena.

**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**
Physical effects and their applications in photonics, electrical engineering, medical engineering and mechanical engineering which become relevant, when technical systems get miniaturized. Surface functionalisation, discretization of energy levels in atomic systems, photonic bad gaps, photonic crystals, quantum dots and quantum wires. New material structures on the micro and nanoscale. Interaction of light with nanostructures leading to novel effects such as plasmonics and opening up new possibilities in optoelectronics and microelectronics.

**FTP_PredMod Predictive Modelling**
Review of the basic concepts of probability and statistics, understanding probability distributions, producing rigorous statistical analysis including estimation, hypothesis testing, and confidence intervals, the application and limitation of regression techniques and time series models are presented, implementations of the algorithms are performed using the statistical software R.

**FTP_Tensors Vectors and Tensors in Engineering Physics**
Elaboration of the fundamental laws of vector analysis, emphasis on balances and constitutive laws, applications in electrodynamics, transport phenomena, mechanical elasticity and piezoelectric elements, description of isotropic and anisotropic effects, e.g. in crystals, application of numerical simulation methods.

**FTP_TheoComp Theoretical Computer Science**
Deepening some basic theoretical aspects of computer science: Formal languages and automata, computability/decidability and complexity.

## Technical Scientific Specialization

**TSM_AdvContr Advanced Control**
Designing of model based controllers, statistical identification of models, designing of LQR regulator, designing of estimators to predict the state of the system, introduction of the concept of stability and robustness, parameter estimation of the model, introduction of methods for nonlinear control systems and model predictive control.

**TSM_AdvElDes Advanced Electronic Design**
Development of high performance electronic systems, combination of analogue circuits and high speed digital signals and designing of mixed signal PCBs, implementation of high speed and high resolution signal processing chains based on A/D and D/A converters, analogue function blocks and complex digital ICs.

**TSM_AdvMech Advanced Structural Mechanics**
Introduction to fundamentals of tensor algebra, gaining comprehensible insight into the governing mechanical and thermomechanical concepts of continuum mechanics. Material models for metals and polymers. Microstructural foundations of failure in metals. Mechanical assessment methods applied in engineering practice.

**TSM_AdvPrPa Advanced Programming Paradigms**
Introduction to functional programming, logic programming and constraint programming, revelation of different benefits and drawbacks with respect to object-oriented programming, simultaneous application of those paradigms and their flawless integration into multiparadigm programming language, specification and verification of imperative programs as a basis for verification of object oriented programs.

**TSM_AdvRobot Advanced Robotics**
Development of competencies in basic and advanced robotics. Leading-edge, innovative industrial and service applications with robot manipulators.

**TSM_AdvTherm Advanced Thermodynamics**
Deepening knowledge of basic thermodynamics including cycles, extension to real fluids, phase and chemical equilibria, thermodynamics including chemical transformations, modeling of complex systems based on balances of conservative quantities with practical examples. Introduction to modern thermodynamic equilibrium solvers (method of Lagrangian multipliers).

**TSM_AnSeqDe Analysis of Sequential Data**
Analysis of time series of different domains and development of statistical models based on the data, in order to forecast future values or classify the time series into predefined categories. Computing the uncertainty of the forecast which has been made. Techniques for analysis of time series, visualization techniques, techniques for characterizing trend and seasonality. Extraction of meaningful features from digital signals suitable for classification, statistical models, such as HMMs or DNNs.

**TSM_AnTeDe Analysis of Text Data**
Introducing the main methods of text analysis using natural language processing (NLP) techniques, from a computer or data science perspective. The methods are introduced in relation to concrete applications, in order to extract meaningful, structured knowledge in several dimensions from large amounts of unstructured texts.

**TSM_AppMNT Applied Micro and Nano Technologies**
Scientific and technological basics as well as possibilities and perspectives of the micro- and nanotechnologies.

**TSM_AppPhot Applied Photonics**
Introduction to the basic physics of light matter interaction. Modern opto-electronics in the field of light detection systems and light sources. Standard components and modern devices like single photon.

**TSM_AutMobRoS Autonomous Mobile Robot Systems**
Combining theoretical foundations for coordinate transformations, sensor fusion, planning and control with examples in ROS. Tests of these complex systems are conducted in simulated environments to speed up development and minimize risk of damage. Data from live tests are recorded for later reuse and analysis as a foundation for further development.

**TSM_AutoSys Automatic Drive Systems**
Concept, dimensioning and development in the servo drive technology sector which are compatible with various industries. Technologies for human motion analysis.

**TSM_BioMedEng Biomedical Engineering**
Introduction of the human musculoskeletal system, its function and biomechanical analysis, pathologies and possible treatment strategies in surgery and rehabilitation, the basic requirements such as biology and physiology, materials used for implants and prostheses and available biomaterials for skeletal tissue regeneration. Current clinical topics such as osteoporosis, fracture fixation osteoarthritis and neurorehabilitation. Treatment methods such as fracture fixation, primary stability and joint replacements. Technologies for human motion analysis.

**TSM_CFD Computational Fluid Dynamics**
Extensive introduction of computational fluid dynamics (CFD), knowledge about modern techniques of numerical flow simulations, emphasis on validation techniques and physical relevance, highlighting the limits of CFD as well as its potential, acquiring systematic routine tackling simulation tasks, understanding of the characteristics behind the code.

**TSM_CompVis Machine Learning in Computer Vision**
Techniques to extract information from images and 3D data, based on machine learning and deep learning methods.

**TSM_CSM Computational Structural Mechanics**
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**
Use of modern database technologies for processing and managing large and shared data collections (RDBMS, current data structures and alternative (e.g. non-relational) database systems). Data warehousing, i.e. data integration and data aggregation. Methods and tools for cleansing, syntesizing and integrating data. Dealing with fuzzy (text) information using databases and search engines.

**TSM_DeLearn Deep Learning**
Fundamental concepts of Deep Learning and application of Deep Learning for Machine Learning tasks.

**TSM_DigHealth Digital Health Systems**
Overview of data management in digital healthcare. Special features and challenges of medical documentation. Underlying ontologies, classifications and scoring systems. BigData technologies. Inclusion of patients in future data collection. Merging of LifeStyle data, vital data and medical documentation. Data reuse from the different medical applications combined with security issus within the emerging Data Science Centers. Software development challenges in the context of the Medical Device Regulation (“MDR”).

**TSM_DigInd Digitalisation in Industry**
Offering an overview of digitization in industry from several perspectives: Product Lifecycle Management, digitization in production, and digitalization of products.

**TSM_EmbHardw Design of Embedded Hardware and Firmware**
Introduction of advanced concepts in modern embedded engineering, implementation of systems on chip designs, application of HW/SW co-design methodologies, verification of embedded systems using HW/SW co-verification, implementation of advanced software optimization techniques, design of SoCs using technologies such as: multiple softcore processors, co-processors and hardware acceleration.

**TSM_EmbReal Embedded Real-time Software**
Description of different architectures of embedded systems, application of modeling frameworks in different environments, design of software architectures and interface specifications based on software requirements, development of applications accessing hardware (drivers, bootstrap, etc. ), transfer of applications from one hardware to another, recognition of synchronous and asynchronous interactions between hard- and software.

**TSM_EnReTe Environmental Remediation Technologies**
Different sources of pollution of soil, groundwater and atmosphere, of measures and technologies to prevent pollution and of contaminated systems and the available technologies for remediation. Process of collection, interpretation and processing up to date information.

**TSM_Heat Heat Transfer**
Introduction to heat transfer theories by conduction, convection and thermal radiation. 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**
Practical design methods for thermal systems such as heating and cooling circuits, solar thermal systems and district networks. Special emphasis is placed on the conditions for safe operation. Design and integration of storage tanks and heat pumps into thermal networks. Building physical aspects and practical rules regarding pipe routing, building integration, and maintenance.

**TSM_InnoDes Novel Innovation and Design Principles**
Creativity and the creative process as a source of innovation, analysis of the push and pull forces and their interaction, strategic guidelines for the research of opportunities and formal processes of product development, evaluation of opportunities and challenges in emerging markets, development of a business plan and its importance for the attraction of resources.

**TSM_IntAuto Integrated Automation**
Selection and determination of individual components, bearing in mind functional aspects, with special attention to functional safety. Drives and sensors, communication and networks, safety engineering in automation technology.

**TSM_ITSec IT-Security**
Developing secure software and exploiting defects in software. Advanced security technologies, which includes authentication, access control, network security devices, and operating system security.

**TSM_Laser Laser and Laser Applications**
Overview about state-of-the-art Laser technology and its applications in industry, R&D, medicine and communication. 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.

**TSM_Logistic International Logistics**
Determination of appropriate logistic strategies for given objectives, rules and regulations of international logistics, technical elements of storage and transport, development of a particular strategy based on knowledge about structures and technological elements, real life case studies.

**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**
Analysis of complex socio-economic systems in their current state and forecasting probable future states, planning, designing and executing qualitative and quantitative analysis, understanding of customer needs, markets and socio-economic environments through well-founded forecasts and scenarios, employing specific tools to define and analyze company reactions to potential future market scenarios.

**TSM_MatSurf Materials and Surfaces**
Fundamental principles about the relationships between structure and property for the development of new materials.

**TSM_MedDD Medical Diagnostics and Devices**
Introduction to the physical and technical principles and applications of important diagnostic modalities. Clinically used modalities and their applications, technical requirements and limitations. Efficient methods for biomedical signal processing and analysis.

**TSM_MedDMA Medical Device Market Access**
In-depth overview on all relevant aspects for successfully introducing a medical device into the market. The corresponding topics include the important tasks during the development of a medical device (prior market access) as well as after its placement on the market.

**TSM_MobCom Mobile Computing**
Development of advanced, native applications for the Android mobile operating system. Solid understanding of mobile computing concepts. Selection of application programming interfaces for on-board sensors and connectivity options for the integration with backend services, IoT platforms and peripheral devices.

**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**
Introduction to engineering and practical aspects of optical components, instruments, and metrology systems. Simple optical components like mirrors, lenses, gratings, filters. Systems like objectives and spectrometers. Complex components, including acousto-optic, electro-optic, and liquid crystal modulators. 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**
Understanding services and their importance, fundamentals of service dominant logic with the co-creation of value, generation and assessment of new services according to the principles of service design, application of service specific models of Operations Management including service optimization and yield management, description of a service from both a provider's and a customer's point of view.

**TSM_PhotoStor Photovoltaic and Storage**
Main components of Photovoltaic PV power generation systems including storage options. Concepts of processes and production lines of such components. Analysis of the economic parameter of PV systems and batteries as well as environmental key factors like energy pay back times. Discussion of power electronic concepts, energy flows and control strategies in these grid connected PV and storage systems as well es levelized cost of electricity.

**TSM_PowElSys Power Electronics Systems**
Presentation of modern switched mode power conversion topologies, modeling of small signals, control methods of topologies, characterization of the magnetic components, modulation schemes and control techniques for medium and high power converters and their application in power grids, modulation techniques and harmonics of three phase inverters.

**TSM_PowGrid Power Grids: Systems and Devices**
Discussion of selected areas of power grids in electricity distribution and transmission: high voltage engineering and relevant design problems; origin of networks failures, consequences, preventing and recovery measures; design, construction and parameters of components in power grids; organization of voltage and power regulation in interconnected grids; special problems in distribution and transmission.

**TSM_PredContr Model predictive control**
Introducing Model Predictive Control (MPC) from the theoretical basics to the use of tool kits to support the implementation and generation of working code. 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.

**TSM_ProcInt Process Integration and Pinch Analysis**
Energy integration of processes with the aid of pinch analysis, predicting energy requirement of a fully optimized plant, economic optimum of investment and operating costs, process integration of utilities such as steam and cooling water systems as well as energy conversion systems like heat pumps and combined heat and power generation systems.

**TSM_Product Product Innovation and Product Lifecycle**
Management Integration of product innovation and development in business processes of companies, deepened knowledge in both development process and product innovation including methods, processes and tools associated such as: strategic production planning, finding of potential and business planning, integral planning of products including life cycle management as well as a variety of product structures.

**TSM_ProgAlg Parallel and Distributed Computing**
Modelling of the most popular parallel infrastructures, choice of suitable parallel algorithms for specific problems on specific architectures, development of efficient parallel programs, load distribution and splitting techniques, investigation of parallel applications and their scalability, modelling communication of distributed systems and their costs.

**TSM_QInOpMgmt Quantitative Methods in Industrial**
Operations Management Formulation of practical questions from Operations Management in the mathematical form of a model, classification of operational issues of Operations Management, high business performance through clever organization and efficient use of resources, application of quantitative methods to Operations Management.

**TSM_ServMan Servitisation of Manufacturing**
Design of new service offerings and creation of innovative value propositions while drawing the costumer journey, identification of improvement areas by business benchmarking and risk management, management of core processes for successful service delivery, development of price strategies for services, design of an integrated ecosystem for services and products.

**TSM_SignProc Signal Processing and Transmission**
Presentation of the state-of-the-art methods of data preprocessing for wireless transmission and the corresponding post processing, modulation formats and their influence on bandwidth, receiver architectures and their range of application, digital signal processing, propagation mechanisms from a length scale of houses (reflection) to a single wave length (diffraction and scattering).

**TSM_SmartSys Smart Systems for Building**
Introduction to smart systems to be found in buildings: Building Automation and Control Systems (BACS), Smart Homes, IoT-solutions, Energy Management Systems (EMS) and building security. Hands-on experiments and common fundamentals like including components, protocols and communication technologies for smart building systems.

**TSM_SoftwEng Software Engineering and Architectures**
Modern software development processes, software architecture, and the principles of evolution of software systems.

**TSM_StatDig Statistical Digital Signal Processing and Modeling**
Introduction to basic digital signal processing, linear algebra and probability theory. Stochastic processes for optimal filtering and spectral estimation problems. Adaptive filters to be used for many advanced statistical digital signal processing problems.

**TSM_ThinFilm Advanced Thin Film Technology**
Introduction to the technology of thin films as core element in the design and fabrication of photonic components. Application of thin films in the field of photonics with the focus on optical coatings. 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**
Dealing with transport phenomena with a focus on technical problems in material, heat and momentum transport, especially in the environment of multiphase flows.

**TSM_UseInf Advanced User Interfaces**
Presentation of a wide range of nonstandard and advanced user interfaces and highlighting their strengths, characteristics and limitations, potential applications such as: voice, gesture-based of haptic user interfaces, design of simple applications and their evaluation, choice of suitable non-standard interfaces for specific tasks and projects.

**TSM_WireCom Wireless Communications**
Physical and data link layers of advanced wireless systems. Functioning of the most important wireless standards with focus on the physical layer and the medium-access layer.

**TSM_WWTreat Environmental Technolgies: Wasterwater Treatment**
Mechanical, chemical and biological processes used for environmental engineering (wastewater treatment). Chemical, physical and biological treatment technologies. Water reuse (greywater) and nutrient recovery.

**TA.MSEFV_VM1 Specialization Project 1**
Acquisition of knowledge and experience in your area of specialisation through challenging research projects, which are normally developed in close cooperation with our industry and business partners or the public sector. The specialization project 1 is worth 12 ECTS.

**TA.MSEFV_VM2 Specialization Project 2**
Acquisition of knowledge and experience in your area of specialisation through very challenging research projects, which are normally developed in close cooperation with our industry and business partners or the public sector. The specialization project 2 is worth 18 ECTS.

**TA.MSEFV_THESIS Master thesis**
Acquisition of more detailed knowledge and experience in your area of specialization through a comprehensive research project that is carried out independently meeting high methodological, conceptual and scientific standards. The master thesis has a high degree of practical relevance and makes a substantial contribution towards the solution of a current practical problem. The master thesis will generally be commissioned by industry, business or the public sector, or else will be a university-internal research project. The master thesis is worth 30 ECTS.

# 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 | 400 – 800 |
| Food | 300 – 400 |
| Public transportation | 50 – 100 |
| Course material | 50 – 100 |
| Health and third party liability insurance | 80 – 100 |
| Clothing, travelling, entertainment etc. | 220 – 400 |
| **Total** | **1,100 – 1,900** |

# 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
will be happy to assist you:

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Further information about
the Master of Science in
Engineering

11-2022