Environmental Engineering Master Program at TUM

The International Master Program "Environmental Engineering" starts with a new program

The Technical University of Munich offers specialization in 11 Fields of Study

Human activities can have severe impacts on the natural environment. Utilization and management of water resources, urban mobility and transportation, energy generation, and urban planning are affecting the environment through multiple interactions. In addition, natural phenomena and hazards can represent serious threats to human activities and human life. In order to address these issues, environmental engineers are trained to manage these vital resources in a sustainable manner. They are able to understand, model and predict the outcome of the interplay of these various factors. Based on this knowledge, environmental engineers develop and apply strategies and technologies for an ecologically, economically and socially sustainable interaction between the natural and man-made environment. The international master program in Environmental Engineering at the Technical University of Munich (TUM) was established in 2006/07. Since then, several revisions have occurred and the current program described in this article is being offered starting in the winter term of 2016/17.

Figure 1:
Environmental Engineering at TUM – Focusing on Water, Mobility and Energy. © TUM

The international master program in Environmental Engineering at the TUM builds upon basic knowledge and competences acquired in bachelor degree programs in environmental engineering or closely related fields. The master program at TUM provides students with advanced knowledge and methodologies within eleven thematic fields of specialization (Fields of Study, FoS) in the area of water, mobility, energy efficiency, and natural hazards. From the list of these Fields of Study, students choose two at the beginning of their program. Independent of their selected fields of study, a common block of 'Cross Cutting Methods' provides graduate students with competences in acquiring, modeling and visualization of environmental data. A broad range of electives (independent modules) is supplementing these specializations. A study project and a 6-month master's thesis both offer opportunities to work on subject-specific topics with an applied or research-oriented focus.

The master program in Environmental Engineering at TUM is designed for 4 semesters and is offered in English. The curriculum consists of a total of 120 credits ECTS, with 78 credits assigned to course and lab work, 12 credits for the applied study project, and 30 credits for the master's thesis (see **Figure 2**).

The Field of Study is the core of the program and provides students with their professional qualification and an in-depth perspective on at least two fields of specialization delivered by various relevant disciplines within the Department of Civil, Geo and Environmental Engineering. Within each FoS, students complete 12 credits of required course modules and a minimum of 12 credits of elective modules. The current Fields of Study offered at TUM are:

Urban Water Systems

Students specializing in this FoS are familiar with energy-efficient water and wastewater treatment processes, water reclamation and reuse, stormwater management, and the design of drainage systems to establish safe and sustainable urban water systems. Students are able to plan and design treatment facilities and processes for traditional and emerging contaminants including process modeling and water quality and performance monitoring strategies. In addition, students are able to design energy recovery strategies and processes from waste streams.

Water Resources Management

Students enrolled in this FoS will acquire profound knowledge about the hydrological cycle and its relation to the biosphere, pedosphere and atmosphere. They understand water related conflicts in national and international river basins and find sustainable solutions by integrating and balancing ecological, social and economic requirements. They are able to apply analytic tools like optimization methods and physically based hydrological models to solve complex water resources challenges like drought and flood mitigation or water quality problems at the catchment scale. Furthermore, the students will evaluate the consequences of man-made deterioration of river courses and alleviate these effects by ecological decentralized restoration measures. They will be able to focusing on integrated water resources management, planning and designing flood protection measures and finding solutions in mitigating ecological impacts.

Hydraulic Engineering

A specialization in this FoS provides students with the competence of modelling, managing and influencing flows and sedimentation processes in rivers and open channels. In addition, students are familiar with the planning and deployment of dams and large-scale reservoirs, construction and utilization of hydropower plants, and flood protection measures. The students are able of ensuring the function of natural river ecosystems in co-existence with human interventions. A special focus of this FoS is on the assessment of

impacts of impoundments and hydropower stations on fish population and appropriate mitigation strategies.

Hydrogeology, Groundwater and Geothermal Energy

Students of this FoS understand hydraulic properties of different aquifer types including hydrological and hydrogeological processes and biogeochemical reactions in subsurface environments. They can also solve problems related to use of geothermal energy and groundwater ecosystems. In addition, students are familiar with the fate and transport of anthropogenic and geological contaminants in groundwater systems and are capable of using numeric models to describe geological and hydrogeological conditions in subsurface environments.

Modeling and Measurements of Flow and Transport

Students of this FoS are capable of modeling flow and transport processes of compounds in the environment. The focus is on development and proper use of micro- and macroscopic models like hydrological models at the watershed scale or turbulent flows of surface water and the atmosphere.

Resource Efficiency in Urban Planning

Students within this FoS have strong competences in designing built environments at various levels (e.g., landscape, urban space, neighborhoods, buildings) aiming for an optimization of primary resource needs and energy consumption. They are familiar with the interdependencies between urban functions and energy consumption; they understand the major factors of energy efficiency of buildings and settlements as well as the material flows from and to the settlements. They develop strategic measures for planning built environments with respect to the goals of sustainable development.

Environmental Geotechnics

Students of this FoS acquire knowledge regarding interactions between geotechnical structures and the environment as it applies to landfill construction, site remediation, groundwater protection for traffic route engineering, and sustainable handling of construction material and byproducts from industrial production. They understand the mechanical and hydraulic properties of soil, rock and mineral residuals. Students are familiar with legal requirements and fundamental methods of foundation engineering and soil mechanics in order to design geotechnical structures and measures to protect the environment.

Environmental Hazards and Risk

Students of this FoS acquire competences to analyze, assess and prevent environmental hazards and knowledge in risk assessment. They are familiar with dynamic changes in the area of water, soil and climate including human activities in order to develop strategies to minimize impacts from human-made and natural hazards. A special focus lies on the topics of Flood Risk Management as well as Landslides and Alpine Hazards. The students understand and analyze the entire flood risk cycle and the interaction of soil, water and rock mechanics including risk assessment, risk analysis, disaster mitigation, preparedness, and disaster response.

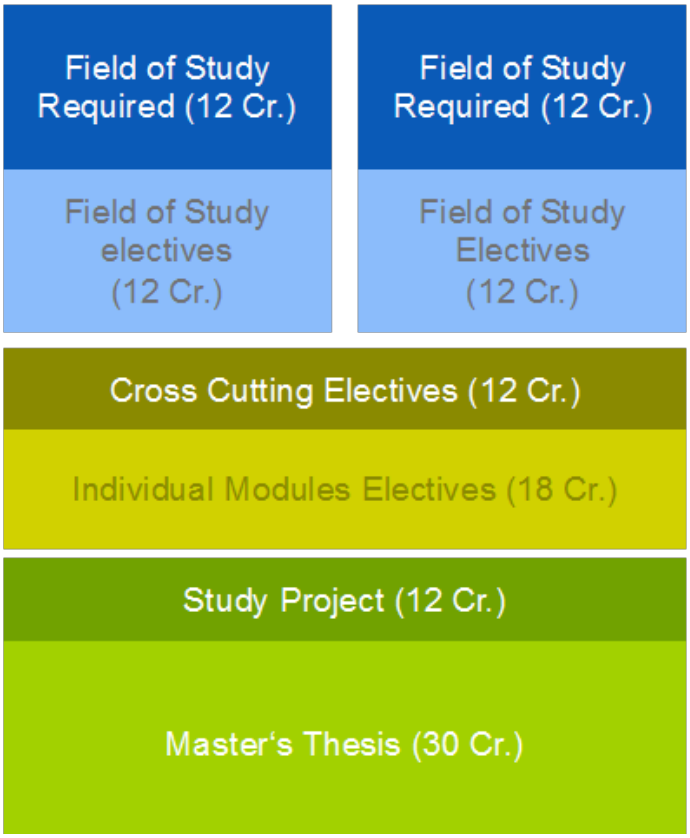

Figure 2: Structure of the international master program in Environmental Engineering at TUM. © TUM

Sustainable Urban Mobility Planning

Students of this FoS are familiar with interactions of urban planning, mobility and transportation; specifically with the mid-term and long-term mobility decisions of travelers and their impact on the sustainability of the transport system. They develop and apply strategic measures of traffic and mobility management aiming in influencing urban mobility with respect to the goals of sustainable urban development, clean air policies and social inclusion. The measures span from planning of land use patterns, strategies of land mobilization, strengthening active modes and neighborhood mobility up to large-scale schemes for pollution control. They are able to model the interaction between land use and transport on mesoscopic and macroscopic levels.

Transportation Engineering and Control

Students of this FoS are acquiring competences in the area of short term mobility decisions and traffic phenomena and their impact on emissions, traffic safety and traffic efficiency. They develop tactical and technological measures by the means of Intelligent Transport Systems in order to influence traffic and mobility with respect to the goals of a holistic and sustainable traffic management. The measures span from mobility pricing schemes, urban traffic control, acceleration of public transport services up to vehicle automation and

eco-sensitive traffic management. They can model the interactions of traffic management and traffic conditions on microscopic and mesoscopic level.

Water-Food-Energy Nexus

Students of this FoS are familiar with the close interactions and competing interests within the Water-Food-Energy Nexus and the need for a better recognition of these issues in decision-making. Students are acquiring knowledge in principles and applications of land management, ethics in science and technology, economics, and policy and regulatory requirements. They also have an understanding of options for renewable energy generation (e.g., decentralized hydropower, biogas, geothermal, wind, solar) and are able to evaluate the consequences of man-made deterioration of the hydrological cycle.

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How to apply

▶ Applying to the Environmental Engineering Master Program at TUM

In order to be admitted to the Environmental Engineering Master Program at TUM, a bachelor degree obtained at a German or international university after at least six semesters of study in environmental engineering, civil engineering or closely related engineering disciplines is required. In addition, applicants whose native language is not English must demonstrate proficiency through an approved test of the English language.

Further information:
www.umwelt.bgu.tum.de

Admitted students can begin the program both in the winter and summer term, however, start in the winter term (October) is encouraged. Application deadlines for the respective semester are May, 31st for the winter term and January 15th for the summer term. We advise International applicants to submit their applications at least six weeks before the deadline, in order to allow an early evaluation of submitted documents.

Applications can be submitted online using the following link:
www.tum.de/en/studies/before-your-studies/application-and-acceptance/w