

Degree Program Documentation

Master of Science

Sustainable Food

Part A

TUM School of Life Sciences

Technical University of Munich

General Information:

- Administrative responsibility: TUM School of Life Sciences
- Name of degree program: Sustainable Food
- Degree: Master of Science (M.Sc.)
- Standard duration of study and credits:
4 semesters of enrollment and 120 credit points (CP)
- Form of study: full-time
- Admission: Aptitude assessment (EFV – Master's)
- Start: Winter semester (WiSe) 2024/2025
- Language of Instruction: English
- Main Location: Singapore
- Additional information: Implementation
German Institute of Science and Technology-TUM Asia
(TUM Asia)
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1 Degree Program Objectives

1.1 Purpose

The challenge of a safe and sustainable food supply presents a considerable problem to the growing global population. World Health Organization (WHO) and Food and Agriculture Organization (FAO) have been leading and promoting circular and sustainable food systems, which require additional food surveillance programs. In particular, the current focus on circular bioeconomy involves the use of by-products and side streams, which currently are wasted or downcycled. Many nations responded to the call- and stepped-up initiatives to safeguard the food systems in their countries.

Apart from these policy targets, we observe in modern societies changing consumers' eating habits towards food, which is more diverse, ethically correct, and environmentally friendly.

Along with these considerations, awareness and demand for higher food quality and standards are increasing. Therefore, it is an obvious advantage for food businesses to embrace sustainability, food safety, and quality assurance to differentiate from the competition.

Food safety can be compromised by harmful bacteria, viruses, parasites, or chemical substances, which are known to cause more than 200 diseases – ranging from diarrhea to cancers. Given that agri-food systems include a global chain of activities, from production, processing, and transportation to consumption, bacterial contaminations, and naturally occurring toxins, e.g., mycotoxins, as well as the use of certain pesticides or chemicals, can affect consumers globally. This is particularly relevant to uncommon food sources from the circular bioeconomy. As technology advances over the years, we have seen several novel solutions implemented and/or proposed. One example is the discovery of the process of contaminant acrylamide in heated potato and cereal products, the content of which could be significantly controlled after its formation and detection have been investigated.

In addition to nutrition and safety aspects, there is a growing popularity of traceability in the food chain, smart packaging, minimal processing, artificial intelligence, 3D food printing, plant-based, eco-friendly, and zero-waste processing technology for a sustainable world.

With these global issues to address, the Master in Sustainable Food aims to provide highly qualified professionals who will hold key positions (e.g., Head of R&D, Head of Quality Management, Risk Manager, Scientific Officer) in the global food industry and governmental institutions (e.g., in research and development, quality management, official food control, as well as academia). To facilitate the research and development process of novel production technologies and strategies in a company, modern food technologists may make use of their competencies in state-of-the-art fields of food processing (minimal processing, 3D food printing, smart packaging, and zero-waste processing), which are still out of scope in many traditional industries. Additionally, they may profit from inter-disciplinary knowledge in food microbiology, chemical toxicology, food chemistry, and analysis to notice and solve food safety-related problems, which up to then may have been undetected by separated segments of the production process. For example, the mitigation of cancer risk due to the process of contaminant acrylamide requires knowledge in precursors, storage and processing parameters, and risk assessment, all together transdisciplinary competencies provided by the Master in Sustainable Food program.

1.2 Strategic Significance

In its basic philosophy, the Technical University Munich is committed to promoting innovation in scientific fields that promise to improve the quality of life and cohabitation in the long term. The responsibility owed to future generations forms the basis for the interdisciplinary focal points of health & nutrition, energy & raw materials, environment & climate, information & communication, mobility & infrastructure.

The Master in Sustainable Food incorporates several of these fields in its strategy, first and foremost health & nutrition.

The program benefits from TUM research focus in the areas of sustainable protein supply (Proteins4Singapore, TUMCREATE), microbiome signatures (DFG CRC 1371) and metrology in food analysis (METROFOOD, EU-ESFRI) while simultaneously expanding the scope of teaching to:

- A diverse international student body from all around the world, specifically from Singapore and the Asia-Pacific region, provides a unique opportunity to learn from and collaborate with students from around the world.
- An interesting and dynamic food industry in the region, with many opportunities for further studies, internships, and employment.
- A focus on sustainable food systems, addressing the challenges of food security, food technology, nutrition, and environmental sustainability.

The Master in Sustainable Food is a unique and exciting program that prepares students to be leaders in the field of sustainable food. The program's location in Singapore, a global hub for food innovation, provides students with access to a world-class research environment and a diverse range of industry partners. The program's curriculum is designed to give students the skills and knowledge they need to address the challenges of the 21st-century food system, such as climate change, population growth, and food waste. The program's graduates can go on to successful careers in various fields, including food science, food technology, public health, and environmental sustainability.

TUM Asia is affiliated with the Technical University of Munich (TUM). As the first German academic venture abroad, TUM Asia is supported by the Singapore Government through the Economic Development Board (EDB) and by the German Government through the Federal Ministry of Education and Research and The German Academic Exchange Service (DAAD). TUM Asia was set up in 2002 with the aim of bringing German academic excellence to Singapore. The academic model employed by TUM Asia places an emphasis on industry readiness and innovation. Blending German academic excellence with industry relevance in Asia, TUM Asia offers Bachelor and Master programs in Singapore with partner universities such as the National University of Singapore (NUS), Nanyang Technological University (NTU), and Singapore Institute of Technology (SIT).

TUM Asia and TUMCREATE's close cooperation and partnership with internationally renowned multinational companies such as Nestlé, Bühler, Symrise, and EIT Food, for example, ensure that they receive highly skilled and creative professionals and students are assured of leading their competition in the global economy. Currently, there are no M.Sc. courses related to Sustainable Food and Food Safety in Singapore or the region. NUS offers a M.Sc. in Food Science and Human Nutrition without having a focus on sustainability or safety. In the region, countries that offer similar

food courses in English are Hong Kong, Malaysia, Thailand, New Zealand, and Australia. However, in comparison, Singapore has the advantage in terms of university reputation, personal safety and cultural diversity.

Graduates interested in research work and want to pursue higher studies can also benefit from this program. TUM educates Ph.D. candidates to perform leading-edge, world-class research. Other universities and institutes are also glad to admit TUM graduates into their programs.

Since 2002, TUM Asia has been running joint Master of Science (M.Sc.) programs conferred by TUM, with NTU and NUS. The specialized M.Sc. programs aim to be in pace with industry trends and needs while constantly challenging the worldview of students with an Asian-European curriculum. Students are able to glean a wealth of knowledge and experience from lecturers and professors coming from as far away as Germany. Students can complete their Master's Thesis and internship in any country of their choice.

TUM Asia fosters talented individuals irrespective of gender, nationality, religion, belief, disability, age, or sexual orientation. We support equal opportunities for men and women, acknowledging and promoting the diversity and differences among our students, regardless of gender, nationality, religion and worldview, disability, age, or sexual orientation. Openness and mutual respect are the basis of intellectual advancement. Diversity among our scholars, scientists, students, and employees makes TUM an innovative and dynamic university. With our motto, "Talents in Diversity" TUM Asia creates a study and work environment where individual abilities can develop and flourish. The result is a study and workplace characterized by vibrant teams, fruitful debate, and outstanding research. Our Academic Service Team offers a broad range of advising and services to support students in all life circumstances.

Globalization is now an inevitable force that is here to stay. At TUM Asia, our classroom reflects this diversity with an enrolment of over 28 nationalities. This means that we foster a vibrant learning environment where the student learns not only from the textbook but also through the lives of their counterparts. Classroom ideas are synthesized across the diverse economic realities, and students learn to see from multiple points of view, creating a capacity to solve problems creatively. The unique degree equips the student with not only technical and scientific knowledge but also with an enriched curriculum composed of business and cultural modules.

2 Qualification Profile

The M.Sc. in Sustainable Food is designed with a holistic approach. The program covers advanced scientific knowledge of the technology and safety of food systems, analytical and critical thinking skills, problem-based learning, presentation and communication of scientific findings, and exposure to the food industry.

The program aims to supply talent and nurture future leaders for the global food system. Students will be equipped with strong ethical standards, teamwork, and communication skills to lead a successful career and contribute back into society.

The training outcomes expected for the students are listed below:

- 1) Increased knowledge in science and deeper insights into various aspects of the global food system.
- 2) Understanding new and emerging technologies, development of trends and anticipating future issues and challenges.
- 3) Development of analytical and critical thinking skills to resolve challenges and complex issues professionally.
- 4) Enhancement of creativity and innovation through problem- and project-based learning.
- 5) Development of research methodologies, data analytics, professional report writing and presentation skills.
- 6) Capability to draft and publish research papers in scientific journals.
- 7) Confidence, efficiency and readiness in addressing global food safety and security concerns.
- 8) Development of technical and non-technical competencies as well as leadership qualities.
- 9) Development of social and interpersonal skills.
- 10) Entrepreneurial thinking and engagement skills.
- 11) Be socially responsible citizens ready to assume leadership roles in their profession, community, and public service.

The following qualification profile corresponds in terms of content to the requirements of the Qualifications Framework for German Higher Education Qualifications (HQR) and the requirements contained therein (i) knowledge and understanding, (ii) usage, application, and generation of knowledge, (iii) communication and cooperation and (iv) scientific self-conception/professionalism. The formal aspects according to the HQR (admission requirements, duration, graduation options) are described in chapters 3 and 6 as well as in the corresponding subject examination and study regulations.

Knowledge and Understanding

The M.Sc. in Sustainable Food covers advanced scientific knowledge of the technology and safety of food systems, analytical and critical thinking skills, problem-based learning, presentation and communication of scientific findings, and exposure to the food industry.

The Master's degree in Sustainable Food qualifies students for both employment as well as further scientific education to provide highly qualified professionals to research and develop novel technologies and strategies for the food industry as well as further scientific education. Graduates know and understand the required mathematic and scientific fundamentals about food science, technology, safety, and engineering. Graduates will be able to apply concepts in Sustainable Food Science and Technology such as food structure design and engineering, rheology and texture of biomaterials, food microbiology and fermentation as well as apply concepts in Food Safety such as food toxicology, quality assurance in food analysis, nutrition and microbiome in health and disease.

Usage, Application and Generation of Knowledge

Successful completion of this program will equip graduates with the following capabilities:

- 1) Knowledge of food technology and sustainability including technofunctionality of food components, advanced food fermentation, food structure and texture engineering, sustainability of food systems.
- 2) Knowledge of food safety including food toxicology, nutrition and microbiome in health and disease, energy metabolism and regulation, advanced food microbiology and safety.
- 3) internship, laboratory skills, and research experience in academia and/or industry
 - Research methods for controlling food-borne pathogens,
 - Determination of bioactive constituents in foods,
 - Methods for biotransformation of food by-products
 - Functional food development and sensory analysis
 - Food processing technologies and applications
 - Molecular biology and cell culture techniques related to food research
 - Internship in Singapore or other countries for industrial experience and exposure
 - Six-month Master research project to work with experts in the field
- 4) Non-technical skills in management, marketing, product and patent, culture, and globalization.

Communication and Cooperation

Students have the necessary linguistic skills to communicate their results and findings effectively in writing and verbally to the scientific and technical communities. They can effectively communicate interdisciplinary solutions and discuss them with a group of specialists while recognizing the opinions

of others. They are capable of leading individuals and groups. Graduates gain employability by the acquisition of practical scientific skills that follow goals and standards of professional behavior in the industry during their internship and Master's Thesis. They build an appreciation of the non-technical aspects of the environment in which scientists are employed, ranging from communication skills to commercial and ethical issues.

Scientific/Academic Self-perception and Professionalism

Students will also gain fundamental knowledge in management, business administration, and production planning in industry. These skills will equip the students to work in multi-national companies and understand the complex structure. It will also enable them to identify market trends and make good decisions about product positioning and planning. They will be able to gain insights and stay updated with research trends in the chemical engineering industry. This knowledge is necessary and valuable in the design of relevant solutions to engineering problems. In addition, they will be able to find answers to complex engineering and professional challenges. They are capable of working in teams, taking responsibility, and making decisions in unpredictable professional and learning environments. They are capable of leading individuals and groups.

3 Target Groups

3.1 Target Audience

This program targets students with a Bachelor's Degree in Food Science/Technology/Engineering and Nutrition or its equivalent in Science/Technology/Engineering. A good understanding of the fundamentals of Food Science/Technology and Safety is strongly recommended for this M.Sc. program.

Around 200 Food Science and Technology graduates from local universities (NUS, NTU, and SIT) attain their first degree yearly. Regional students are also eager to explore overseas study opportunities after their first degree in their home country. The trend for this group is getting higher, especially from China and India.

3.2 Prerequisites

For applicants without English as their native language or medium of instruction during previous studies (e.g., Bachelor), proof of appropriate language skills is required, equivalent to the European Reference Guidelines level C1, such as the „Test of English as a Foreign Language“(TOEFL), „International English Language Testing System“ (IELTS) or the „Cambridge Main Suite of English Examinations“.

TUM will administer the aptitude assessment procedure according to FPSO (examination and study rules) guidelines. Required skills will include basic knowledge in inorganic, organic, and biological

chemistry, mathematics, physics, microbiology, and food chemistry and analysis. This assures that the necessary background is adequate to maintain the high quality of the program.

3.3 Target Numbers

The initial target intake for the Sustainable Food program is 20 students. The target numbers are decided after considering the capacity of the available lecture and laboratory facilities, and the need to ensure an optimal student-teacher ratio and interaction. The program will accept applications from students with Bachelor in Food Science/Technology/Safety/Nutrition/Engineering and equivalent qualifications.

4 Demand Analysis

On top of the global issues discussed in Section 1, various organizations in Singapore have rolled out a series of initiatives to combat the challenges to the local food system, which will be discussed further below.

Singapore has a “30-by-30” vision to grow and provide enough food in Singapore itself to meet 30% of its nutritional needs by 2030. There is also a “Food Innovate” program to increase Singapore’s food manufacturing industry through innovation, with the vision for Singapore to be Asia’s food and nutrition hub by 2025. From this ambition, challenges arise, such as increasing population, low current local production values of less than 10% of Singapore’s demands, and low availability of land area (less than 1%). To safeguard food supply, the Singapore Food Agency (SFA) developed a “Food Security Roadmap” with strategies to diversify food sources and optimize local production. These include support to industries either in R&D, urban farming, reducing food waste, and strengthening the infrastructure or workforce trainings. SFA has set the vision to “Save food for all” and the mission to “Ensure and secure a supply of safe food”.

Currently, the food industry contributes S\$14.4 billion to the economy of Singapore and supports more than 300,000 jobs. Local food manufacturing is worth over S\$4.3 billion and employs more than 48,000 workers. With the increasing demands in the food systems, it is predicted to increase by 5 to 10% annually on talent acquisition in the workforce to drive technology advancement and innovation efforts.

Other ASEAN countries are traditionally agricultural economies with an enormous need to upgrade the traditional (and often wasteful) food processing technology to a higher sustainability model (low carbon food print), reducing waste and ensuring safety and high nutritional value.

Food safety is a severe concern in China and India, two of the world's most populous countries. In recent years, there have been several high-profile food safety scandals in both countries, including the use of gutter oil in cooking and the presence of melamine in milk products. These scandals have highlighted the need for stronger food safety regulations and enforcement in both countries. In addition to more robust regulations, there is also a need to train professionals on food technology and safety. These professionals must be trained in the latest food safety practices and procedures to protect consumers from foodborne illness. There are a number of organizations that are working

to improve food safety in China and India. These organizations include the Food and Drug Administration (FDA) in the United States, the World Health Organization (WHO), and the Food Safety and Standards Authority of India (FSSAI). These organizations are working to develop and implement food safety regulations, train professionals on food technology and safety, and raise awareness of food safety issues among consumers. By taking these steps, China and India can improve food safety and protect their citizens from foodborne illness.

Food safety is a complex issue that requires a multidisciplinary approach. Professionals with various skills and knowledge are needed to ensure food safety, including scientists, engineers, inspectors, and food safety officers. Training on food technology and safety should be ongoing and comprehensive. Professionals need to be up-to-date on the latest food safety regulations and procedures, as well as the latest scientific research on foodborne illness. Training on food technology and safety should be accessible to all stakeholders in the food industry, including farmers, food processors, retailers, and consumers. By training professionals on food technology and safety, we can help to improve food safety and protect public health.

There are many other fields that also welcome our graduates. They will have more opportunities all over Asia, Europe, and other places in the world since there is a high demand for Food Scientists and Technologists skilled in both conventional and leading-edge food technology. Moreover, as food safety has been very poorly addressed in current food science programs at Asian universities and challenges of food safety are increasing with climate change and decreasing agricultural areas, there is an increasing need for graduates' knowledge in food safety.

Graduates interested in research work and want to pursue higher studies can also benefit from this program.

5 Competition Analysis

5.1 External Competition Analysis

The Sustainable Food program will be the first and only of its kind in Singapore and Asia. We will train food scientists with skill sets aligned and relevant to the global food system with a specific focus on sustainable food science and technology on top of food safety. Table 2 shows the strengths and weaknesses of similar programs offered in Asia.

There are no M.Sc. courses related to Sustainable Food and Food Safety in Singapore. NUS offers two Food Science and Technology Master degrees, M.Sc. in Food Science and Human Nutrition by Coursework as well as M.Sc. in Food Science and Human Nutrition by Research program. The focus on food nutrition on top of food science and technology sets it apart from the M.Sc. Sustainable Food, where the focus is on food science and technology on top of food safety.

In the region, countries that offer similar courses in English are Hong Kong, Malaysia, Thailand, New Zealand, and Australia. However, in comparison, Singapore has the advantage regarding university reputation, personal safety, and cultural diversity. The program introduces modules that interest potential students and could benefit the industry in the region, focusing on food technology and food safety.

With the knowledge (technical and non-technical) gained in the course, graduates are expected to have excellent adaptation skills and excel in this fast-paced, ever-changing world, integrating into the future of the global food system. Many other fields also welcome our graduates. They will have more opportunities all over Asia, Europe, and other places in the world since there is a high demand for Food Scientists and Technologists skilled in conventional and leading-edge food technology.

Table 1: Universities offering similar M.Sc. programs in Asia

University	Studiengang	Country	Duration (year)	Tuition fee/year	Weaknesses	Strengths
National University of Singapore	Food Science and Human Nutrition by Research	Singapore	2	~SGD 45k	Expensive. Focus on Food Science and Technology. Little focus on food safety and sustainability.	Top University in Asia. Focus on Food Science and Technology.
National University of Singapore	Food Science and Human Nutrition by Coursework	Singapore	1	~SGD 45k	Expensive. Coursework only. Focus on Food Science and Technology. Little focus on food safety and sustainability.	Top University in Asia. Focus on Food Science and Technology.
The University of Hong Kong (HKU)	Food Safety & Toxicology	China	1	~SGD 15k	Political instability, coursework only	Cheap in terms of tuition fees.
The University of Hong Kong (HKU) Cardiff Metropolitan University	Food Safety Management	China	2.5	SGD 23k	Offer as part-time only, political instability, only focus on safety.	Cheap in terms of tuition fees.
University Putra Malaysia	Food Safety and Quality Assurance	Malaysia	1.5	SGD 9k	Lower university ranking, uncertain of the quality of teaching. Safety issues.	Cheap in terms of tuition fees and cost of living.
Chulalongkorn University, Kasetsart University	Food Science and Technology-Food Security Theme	Thailand	2	Government-sponsored	Lower university ranking, uncertain of the quality of teaching.	Free course, low cost of living.

Murdoch University	Food Security	Australia	2	~SGD63k	Expensive fees and living costs.	The quality of education is commendable. Nearer compared to UK or Europe.
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5.2 Internal Competition Analysis

The Master of Science in Sustainable Food is a unique study program different from the programs conducted at TUM. TUM offers a Master of Science program in Food Chemistry as well as Food Technology and Biotechnology, intending to train students for the demand of industrial food production in Europe, focusing on developing sustainable strategies for supplying society with healthy and safe food. Additionally, the programs offered by TUM have the German language as a mandatory entry requirement. TUM Asia provides a Master of Science program in Industrial Chemistry, intending to develop students into professionals in the dynamically growing chemistry, construction chemistry, and chemical engineering market.

6 Program Structure

The Master of Science in Sustainable Food is a 2-year (4 semesters) full-time research and application-focused program. Students are required to complete 120 ECTS (TUM) and complete 12 modules (8 core and 4 elective modules), a laboratory course, a 14-week internship, and a six-month research Master's Thesis. All modules are taught by lecturers from TUM or experts and freelancers from the industry.

The study program takes place at the German Institute of Science and Technology – TUM Asia (TUM Asia), a 100% subsidiary of TUM located in Singapore. Apart from specialized courses, TUM Asia also offers German language courses stretching over the first two semesters. The following figure shows an exemplary course of study.

Students will start their program with the laboratory course as a refresher for the students who acquired these skills learned in their early undergraduate education. The laboratory course also serves as a foundation-building module for the other technical modules as well as their internship and Master's thesis. Students will subsequently follow up with the core modules to gain fundamental knowledge in Food Technology and Sustainability, including Technofunctionality of Food Components, Advanced Food Fermentation, Food Structure and Texture Engineering, Sustainability of Food Systems as well as knowledge in Food Safety, including Food Toxicology, Nutrition and Microbiome in Health and Disease, Energy Metabolism and Regulation, Advanced Food Microbiology, and Safety.

Students are also required to expand beyond their main topic and take up 4 electives (2 technical and 2 non-technical), gaining knowledge in different topics such as Business Administration, Production Planning in Industry, Project Management Principles, Innovation, and Technology

Management on top of their interest in the technical aspects of Food Science, Technology, Nutrition and Safety offered by TUM. These elective modules serve as catalysts for the students, allowing them to become more versatile in different areas on top of their technical expertise.

During the latter part of the course, students have to undergo a compulsory 14-week internship in the Food Science/Technology/Nutrition/Safety/Engineering industry, allowing students to gain exposure and experience in the R&D field, further enhancing their employability and technical knowledge that is required by the food industry.

The final part of the course is the Master's Thesis. Students must work on a real-world scientific knowledge gap and conduct research in competent research and educational institutes, supervised by experts in academia and industry. The results of their work will have to be documented and presented with good scientific practice. These experiences will be crucial in their future career in the scientific community and industry.

All modules and lectures offered are organized as a block structure, where lectures are conducted within two to three weeks, followed by an examination later. Through the structured organization of the semesters, it is assumed that there is no overlapping of the classes, and enough time for self-study is guaranteed.

The high mobility has been one distinguishing feature of TUM's offshore Master program. The 3rd and the 4th semester are designed in such a way that students can do their internship and/or Master's thesis overseas without having to prolong their studies. TUM Asia encourages this to expose students to different work environments, i.e., multinational companies, research laboratories, and universities in other countries.

Assessment tasks for modules in this program will be clearly stated up-front in the module descriptor. Clear assessment rubrics will also be published and made available to the students before the start of the assessment tasks.

Table 2: Degree Chart M.Sc. Sustainable Food

Semester	Module					Prüfungen/ Credits
1.	LS001TUMA Technofunctionality of Food Components K 5 CP	LS005TUMA Energy Metabolism and Regulation K 5 CP	LS006TUMA Nutrition and Microbiome in Health and Disease K 5 CP	LS009TUMA Laboratory Module L 10 CP		LS012TUMA Economic and Environmental Life Cycle Assessment (elective) K 5 CP 6 30
2.	LS002TUMA Food Structure and Texture Engineering (Food Design) K 5 CP	LS003TUMA Molecular Sensory Science K 5 CP	LS004TUMA Sustainability in Food Systems (required) K 5 CP	LS007TUMA Food Toxins and Toxicants (Food Toxicology) K 5 CP	LS008TUMA Microbial Food Safety from Farm to Fork LP 5 CP	LS014TUMA Molecular-biological methods K 5 CP 6 30
3.	LS011TUMA Research Internship R (CW) 20 CP			TUMA203 Innovation and Technology Management K 5 CP		LS013_TUMA Cellular Agriculture K 5 CP 3 30
4.	LS010TUMA Master's Thesis (Core Module) W 30 CP					30
Legend	grey = core module; light blue = elective module dark blue = core module Master's Thesis					CP = Credit Points; K = Klausur (written exam); L = laboratory assignments; LP = learning portfolio; R = report; W = research paper; CW = coursework

The table shows the recommended modules course sequence from academic year 1 through year 2. The curriculum aligns with the German accreditation system, which advises the upper limit of 6 examinations per academic semester. The internship and thesis are arranged to be during the program's final year. By the time of training, students will have completed all the modules required by this program, except the Master's thesis. They will have built strong knowledge foundations for solving industry problems.

Except for the internship, which will be graded as a non-letter pass/fail grade, the modules will be graded according to TUM's ECTS grading table. The total mark obtained by a student for each module is translated into a letter grade with an assigned grade point and descriptor by the grading scheme. An F grade is deemed a "Failure to attain most learning outcomes". All examinations at TUM Asia are governed under the General Academic and Examination Regulations for Bachelor's and Master's Programs (APSO), in conjunction with the respective school's Study and Examination Regulations (FPSO). Section 1 of the respective FPSO stipulates whether the course of study falls under APSO. The APSO contains binding procedural regulations for all Master's degree programs at TUM. The FPSOs for the individual TUM degree programs then govern the program-specific prerequisites for examination approvals, the examination requirements, and the course of study. Table 3 shows the grading scheme.

Table 3: Grading scheme for the M.Sc. Sustainable Food

Mark Range	Letter Grade	Grade Point (TUM)	Descriptor
85-100	A+	1.0	Excellent attainment of most learning outcomes
80-84	A	1.0	
75-79	A-	1.3	
70-74	B+	1.7	Good attainment of most learning outcomes
65-69	B	2.0	
60-64	B-	2.3	
55-59	C+	2.7	Satisfactory attainment of most learning outcomes
50-54	C	3.0	
45-49	D	3.3	Limited attainment of most learning outcomes
40-44	E	4.0	Inadequate attainment of most learning outcomes
39 and below	F	5.0	Failure to attain most learning outcomes

7 Organization and Coordination

The Master of Science Sustainable Food is offered by the TUM School of Life Sciences of Technische Universität München (TUM) in cooperation with TUM Asia.

- Course guidance [TUM general student guidance office](#) and [TUM Asia](#)
- Academic Service Department In addition to the teaching faculty, a dedicated Academic Services Team at TUM Asia ensures the smooth running of MSc. Sustainable Food, as well as the other programs administered by TUM Asia. This team consists of:
 - 1 Academic Services Manager (ASM, TUM-Asia)
 - 1 Academic Services Executive (ASE, TUM Asia)
- Application The application is submitted to TUM Asia directly. Applicants must complete an online application form and submit the relevant hardcopy documents. [More information](#)
- Aptitude Assessment (EV) Curricular analysis
- Enrollment Students are enrolled at TUM. The communication between the students and the University is handled and coordinated by [TUM Asia](#).
- Academic Services TUM Asia is responsible for student management. An Academic Services Team was set up for this purpose. The department serves as contact point for lecturers and students and handles all academic matters.
- Student Management Committee (SMC)

The student management committee is composed of the class representatives from each program. The SMC is the first contact point for all students, regardless of the nature of the inquiries, program-related or personal. They are responsible for organizing events and outings as well as take care of the junior batch of students. Additionally, representatives from the SMC are involved in the Quality Management of the study programs.

- Program Management Committee (PMC) / Examination Board

The program management committee (PMC) is responsible for examination management. The PMC comprises of the following members:

Prof. Michael Rychlik, Chair of Analytical Food Chemistry (Head), TUM School of Life Sciences

Prof. Dirk Haller, TUM School of Life Sciences

- Quality Management –

Academic and Student Affairs:

TUM-wide: Study and Teaching –
Quality Management (TUM CST)

www.lehren.tum.de/startseite/team-hrs/

Departmental: TUM School of Life Sciences

Team Quality Management / TUM Asia

When it comes to examinations, there are three essential points of contact:

1. The academic student department (ASD) at TUM Asia for the corresponding program, is responsible for organizing coursework examinations in the individual degree programs, examination registration and cancellation, certificates and withdrawals, administration of grades, and the publication of examination results.
2. Each course of study has a corresponding examination committee within the schools, i.e., Program Management Committee (PMC). The committees are responsible for reviewing hardship and exception applications as well as recognizing credit and degree program requirements.
3. The academic student department at TUM Asia creates the Notification of Examination Results on a semester basis as well as degree program documents, degree certificates, examination certificates, and transcript records. The academic service manager (ASM) verifies and confirms the list of graduating students and will prepare the data/documents for printing. Subsequently, the degree certificates, examination certificates, and transcript records are printed after verification. Once the authorized printing company has delivered the documents, the program coordinators and the manager check the documents and send them to the TUM central examination office for verification, the signature of the president, and TUM embossment. After receiving back, the degree scrolls from TUM, and the final documents are released to the student during or after the graduation ceremony, held once a year. The TUM Asia ASD exclusively issues certified copies of TUM-internal graduation documents.

8 Enhancement Measures

Through TUM's commitment to the betterment of society, TUM Asia was set up in 2002 as the first academic branch campus of any German university to bring German academic excellence to Singapore. Though situated in an Asian country, the academic model employed by TUM Asia is nevertheless German in its roots, emphasizing on industry readiness and innovation. Blending German academic excellence with industry relevance in Asia, TUM Asia offers Bachelor and Master programs in Singapore with partner universities such as the National University of Singapore (NUS), Nanyang Technological University (NTU), and Singapore Institute of Technology (SIT).

The study program, study-related organizational unit, and the HEI have a quality management system with defined organizational and decision-making structures to guarantee the systematic further development of the study program.

The Program Management Committee (PMC) and TUM Asia are responsible for quality management and development of the program. It comprises two representatives from the TUM School of Life Sciences.

TUM Asia has always emphasized high quality, which is aligned with TUM's quality management. Technicality aside, attention is also given to other facets like strategy, objectives, requirements, and other administrative matters. Since our courses must meet the TUM quality management study regulations, the responsible units at TUM are involved from the beginning. This includes the definition of the process, the conceptual draft's design, the course documentation's preparation, module descriptions, and the articles of association. The relevant center and decentralized TUM committees set up the facility. The programs are developed according to the prevailing laws imposed by TUM.

For further details please visit the links below:

<https://www.lehren.tum.de/themen/studiengaenge-gestalten/neue-studiengaenge-und-satzungsaenderungen/>

<http://www.gesetze-bayern.de/Content/Document/BayStudAkkV/true>

More information regarding quality management from TUM can be found under the following link:

<https://www.lehren.tum.de/themen/qualitaetsmanagement/>

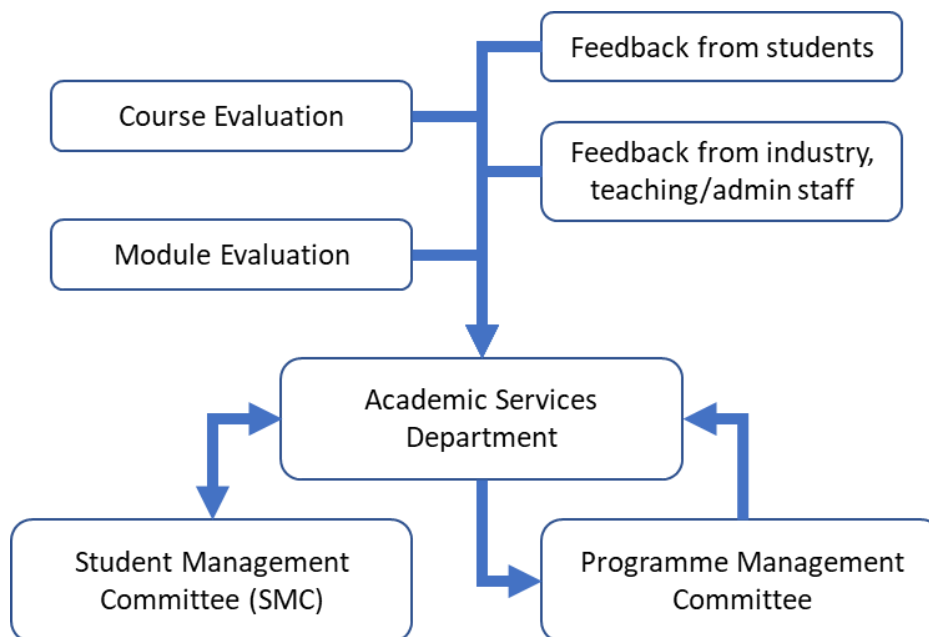
Further development of the courses also takes place with the involvement of these institutions of TUM. Existing courses are continuously developed and performed in close collaboration with the responsible program committee and other units at TUM.

The standard processes for quality assurance are described in the flowchart below. The courses are evaluated by a web-based system evaluation program ("Evasys"), which is suitable for standardized apprenticeship evaluations of different dimensions. The results are shared with the teaching staff, who can share their opinions on the feedback. Additionally, the feedback from students, graduates, teaching staff, and administration staff is collected and processed by Academic Service Department (ASD). The compiled information is then discussed with the SMC and in the annual PMC meetings, wherein steps are taken to work on the feedback and fulfill the shortcomings. An additional tool to maintain the quality of the courses is the course evaluation. This is done yearly, specifically at the

end of the second and fourth semester. This process ensures that all stages of the programs are captured.

The complete information is then compiled by the manager from the academic service department and presented in the PMC meetings. The PMC, which also consists of members from TUM Asia, e.g., the managing director, respective faculty, and manager from the academic service department, has yearly meetings. These meetings serve as a platform for scouting possible improvements in the program and discussing difficulties faced by teaching or administration staff that year. A typical agenda for the meeting would cover the following topics: admission and study progress, scholarships for students, academic performance, curriculum, lecture, and course evaluation and necessary measures, internship and master thesis placements of the students. Additionally, decisions taken in the past are reviewed and adjusted if necessary. Relevant findings are shared after the PMC meetings with the students, usually during tea sessions.

Quality assurance flow chart for the joint degrees at TUM Asia



Furthermore, TUM Asia has regular meetings with industrial partners, where new specializations and changes in the course (structure, elective modules) are presented. This internal process has proven to be a very efficient mechanism, which led to significant improvements in the curriculum so that graduates remain relevant in the chemical industry after graduation.