Technical University of Munich (TUM) Asia

TUM Asia

MASTER OF SCIENCE

Industrial Chemistry



At a Glance

- The best of German and Asian research and technical expertise
- Nurturing specialist chemical engineers equipped with cutting-edge skills
- Joint degree conferred by TUM and NUS
- Vast career prospects regionally and worldwide
- Apply online at **www.tum-asia.edu.sg**

NUS National University of Singapore

Technical University of Munich

www.tum-asia.edu.sg

About
TUM & NUS

Technical University of Munich (TUM)

The Technical University of Munich (TUM) was founded in 1868 and is one of Europe's leading technical universities. Serving as an entrepreneurial university that promotes talents and creates value for society, TUM has produced 19 Nobel Prize winners since 1927, most notably Ernst Otto Fischer (Chemistry) and Rudolf Mößbauer (Physics). Its focus areas are engineering sciences, natural sciences, life sciences, medicine, management and political and social sciences.

TUM promotes talents with its network of strong partners in research and industry. It is represented worldwide with the TUM Asia campus in Singapore, as well as offices in Beijing, Brussels, Cairo, Mumbai, San Francisco and São Paulo.

In international rankings, TUM regularly places among the best universities in Germany and worldwide. It is the only university to have won recognition as a German 'Excellence University' in every round since 2006.

Technical University of Munich (TUM) Asia

The Technical University of Munich (TUM) Asia was set up in 2002 as the first academic venture abroad by a German university, blending German academic excellence with industry relevance in Asia. Its partnerships with top Asian universities and industry leaders combine German engineering with Asian relevance to equip talents for industry and research sectors in the world.

With the changing needs of the economy, the specialised master's programmes that are offered keep pace with industry needs through an Asian-European perspective. Lecturers and professors hail from as far as Germany to equip students with their rich knowledge and experience.

National University of Singapore (NUS)

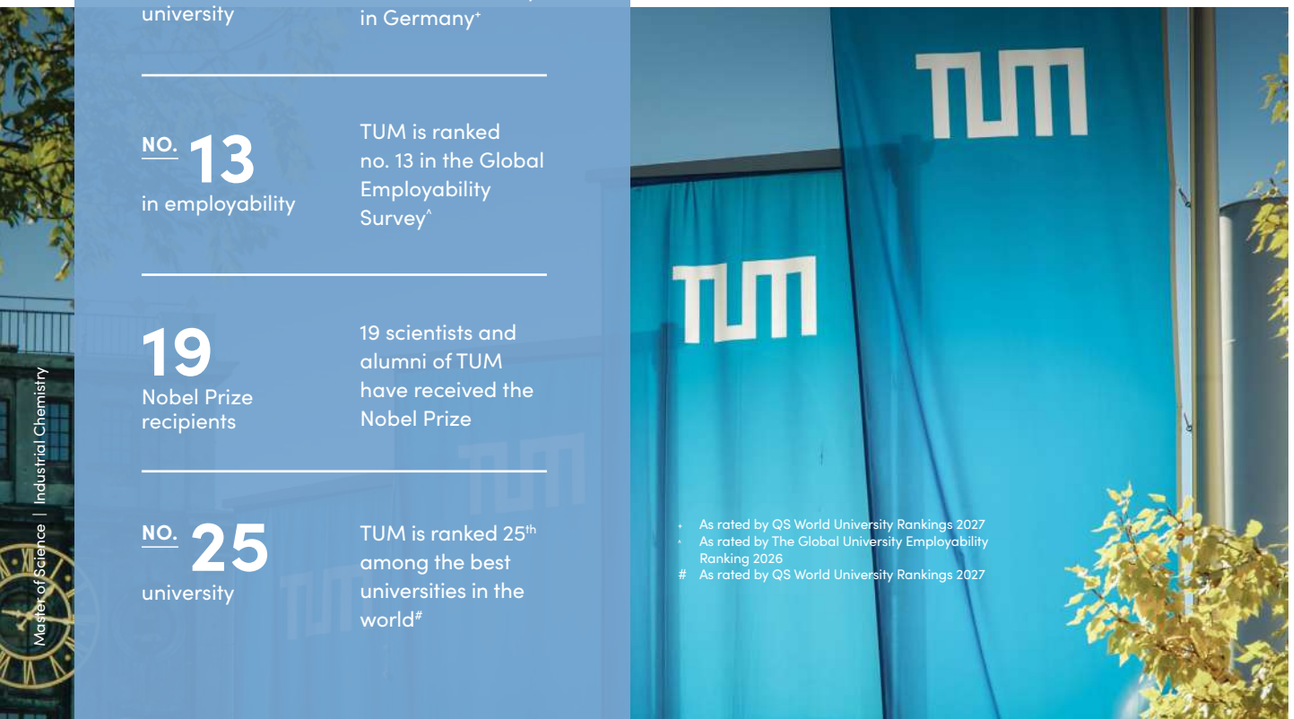
Founded in 1905, the National University of Singapore (NUS) is today widely known for its innovative and rigorous education which has nurtured generations of leaders and luminaries across industries, professions and sectors in Singapore and beyond. The university's singular focus on talent will be the cornerstone of a truly great university that is dedicated to quality education, influential research and visionary enterprise, in service of country and society.

NO. 1 university
TUM is ranked as the no. 1 university in Germany*

NO. 13 in employability
TUM is ranked no. 13 in the Global Employability Survey^

19 Nobel Prize recipients
19 scientists and alumni of TUM have received the Nobel Prize

NO. 25 university
TUM is ranked 25th among the best universities in the world#



* As rated by QS World University Rankings 2027
^ As rated by The Global University Employability Ranking 2026
# As rated by QS World University Rankings 2027

Master of Science | Industrial Chemistry

Programme
Overview

Jointly awarded by TUM and NUS, the **Master of Science in Industrial Chemistry (MSc in IC)** is competitively designed to nurture the next generation of specialist scientists and engineers in the pharmaceutical, fine, and specialty chemicals industries. This joint programme builds a strong foundation in catalysis, inorganic materials, reaction engineering, and polymer chemistry, with a strong focus on AI-driven automation and sustainability.

Programme Structure and Timeline

12 modules
- 5 Core Modules (5 Lab Courses)
- 3 Technical Elective Modules (TUM)
- 2 Non-Technical Elective Modules (TUM)
- 2 Non-Technical Elective Modules (NUS)

45 contact hours
for every Core, Elective Module and Lab Course

2 Years
- Full-time programme
- Coursework in Singapore
- Internationally-recognised degree

July	Year 1	Year 2	Graduation
Arrival in Singapore	• Core Modules • Lab Modules • Elective Modules	• Elective Modules • 1-Month Industrial Chemistry Lab Course in Germany • Internship • Master Thesis at a company, or university	End of programme

Note: This outline is a general reference to the duration of study. A student's actual duration of study may or may not follow this general reference. This outline is subject to change during the course timetable.

Programme Modules

Core Modules

Industrial Chemistry Laboratory Course (In Germany)

Student will embark on their own scientific project while attached to one of various research labs in TUM for topics related to Chemistry and/or Chemical Engineering.

Organometallic and Coordination Chemistry

The applications of organometallic, inorganic and bioinorganic catalysts in industry and research are described. Basic reaction mechanisms and the constituting elementary reactions are introduced and possibilities for the immobilisation of homogeneous catalysts are described. An overview of the development of organometallic chemistry and catalysis and its implication on industrial chemistry throughout the existence of chemical industries are given.

Inorganic and Material Chemistry

The course includes the descriptive chemistry of many of the most common elements and their inorganic compounds, integrating such topics as symmetry and structure with the emphasis on solid-state structures of metals, salts, and extended covalent systems, bonding models, reactions and the synthesis and characterisation of inorganic compounds, including basics of crystallography.

Chemical Reaction Engineering

The course covers the thermodynamics and kinetics of chemical reactions, mass/heat balances, performance equations and residence time distributions in ideal and real reactors, as well as the link to micro and macro-kinetics (mass transfer on phase boundaries, pore diffusion, adsorption) and catalysis (kinetic models and principle reaction mechanisms).

Polymer and Macromolecular Chemistry

This course covers the classification of synthetic macromolecules by properties, structure and reaction type (free radical, ionic and coordinative polymerisation as well as polycondensation); ideal and real kinetics of polymer formation; molecular mass determination and molecular mass distributions; process technology of polyreactions and processing of plastics; reactor technology, discontinuous and continuous process control; and influence of process parameters on molecular mass distribution.

Technical Elective Modules

Data-Driven Automation and Robotics in Industrial Chemistry (TUM)

This module covers the design and implementation of data-driven automation workflows for chemical laboratories using Python and ROS, alongside process modeling through state machines and flow diagrams. Students will learn to integrate sensors, actuators, and robotic systems, apply data science and machine learning methods for optimisation and analysis, and develop effective human-machine interfaces (HMI) with a focus on usability and safety. Emphasis is also placed on critically evaluating automation systems in terms of reliability, scalability, robustness, and data integrity.

AI-Inspired Green Construction Using Advanced Chemistry (TUM)

The module covers the following topics:

- Fundamentals of global warming – causes, effects, global strategies
- Contribution of construction & built environment to CO_2 emissions
- Fundamentals of artificial intelligence (AI) – concepts, major applications, market players
- Cement technology: how cement is produced, composition, chemistry, environmental impact
- Hydration of cement: chemistry, engineering properties of cement
- Application of AI to optimise cement properties and environmental impact
- Chemical admixtures for concrete: polymer synthesis, characterisation, effect on cement
- Classification of chemical admixtures: polycondensates, polycarboxylates, small molecules etc.
- Application of chemical admixtures in 3D printing of concrete using robots
- Future construction with robots: optimization based on AI

Drug Discovery Chemistry (TUM)

The module covers the following topics:

- Introduction to the drug discovery pipeline.
- Presentation of different families of therapeutic agents (anticancer, antibacterial and antiprotozoal).
- Drug formulation and delivery. Pharmacokinetics & Pharmacodynamics concepts and information on the drug approval process in different countries.
- The various topics will be presented also with the help of case studies from literature.

Chemistry in Energy Conversion (TUM)

Chemical processes in conventional and renewable energy conversion will be discussed. A broad general overview is provided before the lecture will cover in more detail catalytic processes related to energy conversion. It will be discussed how sustainable energy supply systems are supposed to be reached based on the current state of the art. In detail, the lecture covers classical catalysis in (petro)chemical and syngas/biogas conversion, chemistry in solar cells, photoelectrocatalysis, catalysis in electrochemistry (electrolyzers and fuel cells), and gas-solid photocatalysis for solar fuel synthesis.

Reactor Design and Process Intensification for Sustainable Chemical Engineering (TUM)

This graduate-level course delves into the principles and applications of chemical reaction engineering and reactor design with a strong emphasis on sustainability. Students will explore advanced topics combining reaction kinetics (knowledge from the core module) and transport phenomena, applying these concepts to the design and optimisation of chemical reactors within the framework of process intensification. The course emphasises the integration of sustainability principles, focusing on reducing environmental impact, enhancing energy efficiency, and utilising renewable resources. Key topics include catalytic mechanisms, reactor modeling and simulation, and scale-up processes. Students will learn to design various types of reactors, such as batch, continuous stirred-tank, and plug flow reactors, fixed-bed, moving-bed and fluidised-bed technology as well as microreactor technology considering economic constraints. The course will cover life cycle assessment (LCA) and process intensification strategies to promote greener chemical processes. Through a combination of lectures and case studies students will develop the skills necessary to innovate and lead in the field of sustainable chemical engineering. By the end of the course, participants will be equipped to design and optimise reactors that not only meet industrial demands but also adhere to the principles of sustainable development, preparing them for roles in academia, research, and the chemical industry.

Industrial Bioprocesses and Technical Biocatalysis (TUM)

This module covers technically relevant biocatalytic processes, focusing on whole-cell systems for food, pharmaceutical, and high-value chemical applications. Students learn to analyse and apply biochemical and bioprocess engineering principles—including enzymatic conversion, immobilisation, and downstream processing—to solve industrial challenges. Aligned with the UN Sustainable Development Goals, the course explores Green Chemistry principles, atom economy, E-factor, Life Cycle Assessment (LCA), and carbon footprinting using tools like SimaPro, GaBi, and Aspen Plus. Key topics include renewable feedstocks, alternative solvents, waste minimisation, process safety, electrification, and emerging technologies like photochemistry and CO_2 utilisation. Learning is reinforced through lab work, case studies (e.g. citric acid production), guest lectures, and a group project redesigning an industrial process for sustainability.

Non-Technical Elective Modules

Business Administration

The primary purpose of the module is to introduce students to the different areas of business administration, while the final objective is to give them a basic understanding of how to face decision problems in a company. Most importantly, we will analyse long-term investment decisions, how to set up strategic planning in a company, how to gather timely information about the current situation of a company, and how to set up its long-term financial structure.

Production Planning in Industry

Manufacturers are confronted with special requirements of their production processes. Cycles, by-products, batches and campaigns are difficult to handle by Enterprise Resource Planning (ERP) software packages nowadays. Concepts of material requirements planning and supply chain management (SCM), combined with basics in cost accounting, will be explained.

Innovation and Technology Management

The lectures will cover the following topics: innovation vs. invention, creating value through innovation, the four forces of innovation, value to the customer, hi-tech marketing, business system innovation and service innovations, technological discontinuities, S-curves and scenario techniques, venture capital, as well as start-ups and financing of innovation, among others.

Industrial Marketing

Marketing strategies are developed for a typical chemical commodity and speciality business. Students will work in teams to develop business cases, make their own business decisions and develop marketing concepts based on provided information of a real case study.

Modern Developments in Industry

The module will provide insights in the core elements of Industry 4.0 such as: introduction to Cyber-Physical System, Radio Frequency Identification (RFID) technologies, information collection with intelligent sensors, industrial networking to connect the machines and processes together, Manufacturing Execution System (MES) for order management, production control and value adding to the complete supply chain management.

International Intellectual Property Law

This module will give a brief introduction to intellectual property rights and focus on insights into general principles of patent law, as well as international conventions governing the patent law. Current developments and criticism of the current patent law system will also be addressed. In addition, practical legal aspects of the commercialisation of patents will be dealt with.

Paradigm Shift to Industry 4.0

Introduction to Industry 4.0; Core elements of Industry 4.0; Fundamental workshop on AR/VR and digital twin; Fundamental workshop on additive manufacturing; Fundamental workshop on collaborative robot; Site visit and workshop on indoor vertical farming with disruptive technologies; Case study on Aquaculture 4.0; Site visit to Competence Centre for Digitalisation, Technology and Innovation (CDTI) and Advance Manufacturing Transformation Centre (AMTC).

Cyber Physical Systems

Introduction to Cyber Physical System; Elements of Cyber Physical System and its importance for a smart production system; Communication networks and the physical systems within a single entity; Overview of technologies enabling connectivity, open communication protocols, and cooperation between systems in a highly digitalised manufacturing environment; Essentials of a digital representation of a networked Cyber Physical System; Cyber Physical System for advanced digital manufacturing; and Case studies and discussions

Industrial Additive Manufacturing Quality Certification

Introduction to additive manufacturing and fundamentals of AM processes; Status quo of industry and first steps to AM production; Health and safety in AM; Quality and production management in AM; Risk assessment and management in AM; Industry standards in AM.

Augmented Reality, Virtual Reality and Digital Twin

Fundamentals of AR/VR technology; Benefit of AR/VR application in production environment to increase work efficiency; Hands-on exercises to access information about production operation; Considerations for AR/VR development; Virtual design and commissioning of a factory layout; Design and verification of a manufacturing process in a 3D environment; Human modelling and ergonomics.

Project Management Principles

Project Management Principles, Project Performance Domains, Project Initiation, Project Planning, Project Execution, Project Monitoring, Project Closing, Agile Project Management.

*__Disclaimer:__ Elective modules available for selection are subject to availability. Unforeseen circumstances that affect the availability of the module include an insufficient number of students taking up the module and/or the unavailability of the professor. NUS and TUM Asia reserve the right to cancel or postpone the module under such circumstances. TUM Asia will update the list of non-technical electives from time to time. Kindly refer to our webpage for the updated list of non-technical electives.

The TUM Experience



The excellent academic education that tackled cutting-edge topics in daily industrial business provided me with a sound understanding of how modern companies work. This unique combination equipped me with the right skills to drive value innovation in my projects.

Korwin Schelkle
Alumni
Master of Science
in Industrial Chemistry

Entrepreneurial Thinking and Engagement

You will formulate and discuss ideas based on the diverse economic realities and learn to see from multiple vantage points. The unique joint degree programme equips you not only with the technical knowledge, but also with the business and cultural aspects of the subject.

Highest International Standards

You will receive a holistic learning experience with the local lecturers from academia and industry. Our TUM modules are covered by professors who fly in from Germany on an exclusive teaching basis to ensure that you receive their undivided attention.

TUMCREATE

TUMCREATE was founded in 2010 as a research arm to foster research collaborations between TUM, Singapore and other top universities in the world in the advancement of electromobility, smart cities, medical technology and now food science. To date, TUMCREATE contributed more than 650 publications, developed 10 patents and innovations with more than 69 PhD candidates successfully trained in various specialisations. Graduates have the opportunity to apply for positions at TUMCREATE, especially if your interest lies in the areas of energy, medical technology and food science.

Industry Relevance

Our professors - the world's best – are industry experts and active researchers. This allows you to learn from a curriculum that is built around the latest technological trends and knowledge.

Global Prospects

You can choose to complete your internship and thesis in Singapore or anywhere in the world with a company, university or research institute. Your internationally recognised degree and experience is a great boost to your profile for future global job opportunities.

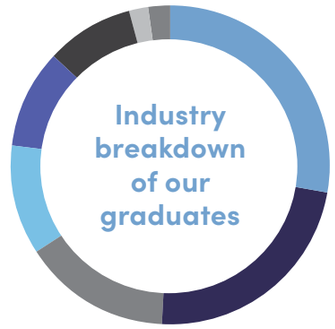
Industry Outlook

Did you know that **the core of the chemical industry is shifting to Asia by 2030?**

The Chemical Industry in Asia

The current growth rate of Asia cannot be matched by any other region in the world. In the past two decades, Asia has driven economic growth and almost half of global chemical sales are owned by chemical companies from Asia. As the global economy expands towards the east, by 2035, at least half of the top 10 chemical companies will be based in Asia or the Middle East. To satisfy the demand in Asia, several European chemical companies have already shifted their activities to Asia and will continue to do so. Several key end markets have been driving the demand for chemicals, such as the automotive, construction and pulp industries.

Additionally, more than 50% of worldwide building activities are taking place in Asia. Today, China accounts for 60% of worldwide cement production, followed by India. Besides building activities, new construction and renovation projects are partially associated with enormous increases in energy consumption, something which is in turn detrimental to energy efficiency and can be reduced by "intelligent materials". The construction industry is the most important industry in China and India. Other Asian countries, such as Vietnam and Thailand, are experiencing a construction boom with significant growth rates and infrastructural improvements. Tomorrow's chemical experts are required to be versatile strategists and should seize the opportunities in the Asian chemical industry.



Source: A.T. Kearney, Inc., Singapore Economic Development Board

Our Graduates

Our graduates in Industrial Chemistry are employed all over the world, with a majority in Singapore, China, India and Europe.

The most commonly accepted positions are Chemist, Process Engineer, Product Manager, Production Manager.

Others may also choose to continue their academic journey with a doctoral candidate position (PhD).

Singapore is

1

of the leading energy and chemical hubs, while being home to some of the world's largest chemical plants.

Half of the top

10

chemical companies in the world will be Asian or Middle Eastern companies by 2030

Singapore is the

18TH

largest exporter of oil in the world, despite not having a single drop of oil reserves. It exports 1.374 million barrels and imports 1.195 million barrels of oil per day.

The market share of sales for the chemical industry in Asia is projected to rise from 49% in 2010 to

66%

in 2030



Programme Fees

	Before GST	After GST
Registration Fee[+] Per application	SGD 5,000	SGD 5,450
Tuition Fee[+] Industrial Chemistry	SGD 56,500	SGD 61,585

Scholarships & Grants

For more information, please visit: https://tum-asia.edu.sg/admissions/graduate-studies/scholarships/

Admission Criteria

- **Bachelor's degree** in **Chemical Engineering or Chemistry** or a closely related discipline
- **Bachelor's degree certificate** or **enrolment letter*** (if you have not completed your bachelor's degree)
- **Academic transcripts** or **mark sheets**, including the credits/grading system of your university*
- **Statement of purpose** indicating the reason(s) you are interested in this programme
- **Curriculum Vitae / Résumé**
- **TOEFL** test score (≥88 for Internet-based test, DI code: 7368) or **IELTS** test score (≥6.5 overall) taken no more than two years ago from date of submission
- **Cambridge Main Suite of English Examinations**
- **Akademische Prüfstelle (APS) certificate** for applicants who hold a degree from China, India and Vietnam

The full application process and documents required for submission is available at www.tum-asia.edu.sg/admissions/graduate-studies/application/

Applications open on 1 October every year.

[+] Tuition fees are to be paid in 3 instalments.

The tuition fee includes teaching fees, laboratory expenses and cost of mandatory events. The tuition fee does not include airfare, accommodation, living expenses, and miscellaneous fees (inclusive of registration, IT facilities, matriculation, examination, amenities, copyright, sports, and medical insurance). These fees will be separately borne by the student.

The tuition fee stated is accurate as of Sep 2026. All fees quoted are in Singapore dollars and are subject to the prevailing Goods and Services Tax (GST) rate imposed under the Singapore GST Act. Final tuition fees are subject to revision due to changes in GST rate and/or at the discretion of TUM Asia, and students will be informed accordingly. Please refer to our website for the final tuition fee and other fee updates.

* Documents which are not in English must be translated by a certified translator. Credits/grading system of your university is required:
- min. passing score (e.g. 50 out of 100);
- max. possible score (e.g. 100 out of 100); and
- the equivalent score/range of scores for each grade (e.g. 'A' grade is equivalent to a score of 90 to 100).

TUM Asia

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