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

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 17 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.

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

NO. 6 in employability
TUM ranked no. 6 in the Global Employability Survey^

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

50 universities
TUM is ranked among the world's Top 50 Universities#

Technical University of Munich (TUM) Asia

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 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)

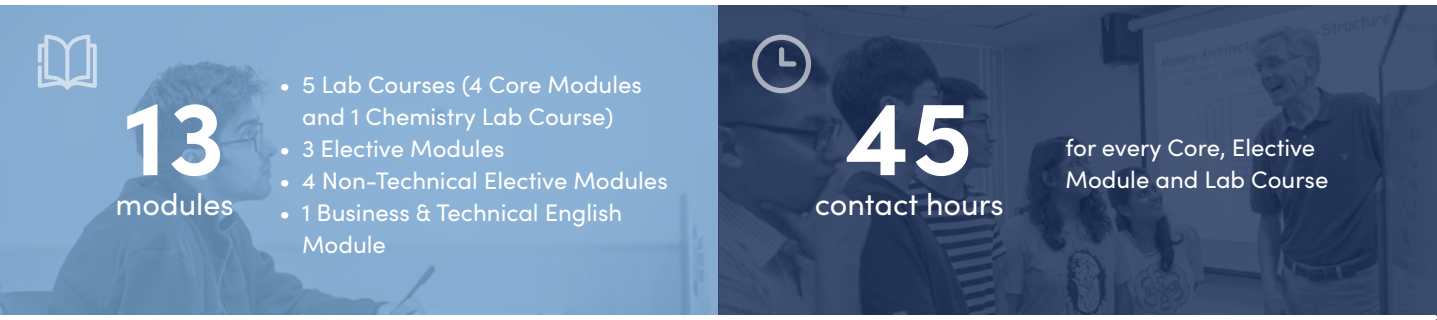
Founded in 1905, the National University of Singapore (NUS) is today widely known for its innovative and rigorous education which has nurtured generations of leaders and luminaries across industries, professions and sectors in Singapore and beyond. The university's singular focus on talent will be the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

* As rated by QS World Ranking 2015 -2019 and Academic Ranking of World Universities (Shanghai ranking) 2011 - 2013, 2016
^ As ranked in the 2018 & 2019 Global University Employability Ranking by Times Higher Education (THE)
# As rated by Times Higher Education World University Rankings 2020, QS World Ranking 2018 and Academic Ranking of World Universities (Shanghai ranking) 2016 - 2018

Programme Overview

Awarded by TUM and NUS, the **Master of Science in Industrial Chemistry (MSc in IC)** aims to groom future leaders in selected areas of technology. It is an enriching postgraduate course for specialist engineers in the pharmaceutical, fine & speciality chemical industries.

Programme Structure and Timeline



13 modules

- 5 Lab Courses (4 Core Modules and 1 Chemistry Lab Course)
- 3 Elective Modules
- 4 Non-Technical Elective Modules
- 1 Business & Technical English Module

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	• Business & Technical English • Core Modules • Lab Modules • Elective Modules	• Elective Modules • Internship • Master Thesis at a company, university or research institute (Supervised by an NUS or TUM professor)	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

Pre-essential Modules

1.1 Business and Technical English

The module aims to teach students technical writing techniques and to familiarise them to different business communication styles. Students will learn the international usage of the English language in technical communication, especially in academic writing, as well as learn how to make effective presentations and prepare technical or scientific papers.

1.2 Chemistry Laboratory Course

During the laboratory course, students need to perform six inorganic chemistry experiments: Complexometric titration of copper, Iodometric titration of copper, Identification of anions Organic/ organometallic chemistry experiments, Synthesis and separation of nitrophenol, Synthesis and purification of an alkyl-methyl imidazolium salt, and Synthesis of Ag-NHC complex.

Core Modules

2.1 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.

2.2 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.

2.3 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).

2.4 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.

Specialisation*

(Pick 1 Specialisation)

SPECIALISATION 1: Catalysis and Petrochemistry

3.1 Molecular and Heterogeneous Catalysis

Both homogeneous and heterogeneous catalysis will be described, and important applications will be exemplarily described. An understanding of the principles of catalysis and the demands on efficient catalysts will be provided. The principles of establishing catalytic mechanisms will be outlined.

3.2 Petroleum and Petrochemical Processes

The scope of the module is to enable students to understand the principal processes involved in petroleum processing in the interface between petroleum refining and a petrochemical plant and in major petrochemical operations. This includes: basics of crude oil chemistry, distillation of crude oil, catalytic conversion and upgrading processes, thermal conversion and upgrading processes, production and management of hydrogen, as well as basic petrochemical processes.

3.3 Unit Operations

The scope of the module is to enable students to understand the principles and the applications of unit operations involved in petroleum and petrochemical processes. This is aimed at providing the skills in the following fields: thermal unit operations, mechanical unit operations and reactor technology. The course teaches the qualitative and quantitative basic engineering principles used to design and to operate mechanical, thermal, and chemical units of a process plant.

SPECIALISATION 2: Building and Material Science

4.1 Building and Construction Chemicals

The module will cover the following topics: chemistry of inorganic and organic binders, details on materials such as Portland, aluminate cement, CaSO4 binders, silicons, epoxy resins, polyurethanes and latex dispersions. In addition, the lectures will give an overview of the physical properties and nanostructures of building materials, surface properties, corrosion processes, sol-gel processes, solid state chemistry, geopolymers, and interactions on polymer-cement surfaces.

4.2 Material Chemistry and Engineering

The module covers the chemistry and engineering of the materials together with details on the structure and properties of the materials such as cement, concrete and steel. The following topics will also be covered in the lectures: physical, chemical and mechanical properties of typical construction materials, the relationship between properties and structures, multi-scale materials and structures, characterisation methods for materials at diverse scale, and application of materials in building engineering.

4.3 High-Performance Polymers

The module covers the following topics: characterisation of polymer admixtures for cement, mortar and concrete. The following subjects will be presented: analytical techniques and processing methods, waterproofing materials, heating insulating polymer foam, fibre reinforced polymer (FRP), polymer latexes and re-dispersible powders used in construction applications, and major properties of polymer dispersions and the characterisation methods.

SPECIALISATION 3: Interdisciplinary Combination

5.1 Module from Specialisation 1
5.2 Module from Specialisation 2
5.3 Module from Specialisation 1, 2 or elective module

Non-Technical Elective Modules

6.1 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.

6.2 Legal and Safety Aspects in the Industry

This module will cover a brief description of the history of law, legal theories and importance of law for commercial life, as well as the evolution and development of the legal systems "common law" and "civil law". The course aims to provide an understanding of the common routes of both these legal systems as well as the fundamental principles and differences between both legal systems, contract law and tort law. Basic principles of the UN Conventions for sales of goods as well as latest developments within the EU legislation pertaining to environmental and IT regulations will also be covered.

6.3 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.

6.4 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.

6.5 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.

6.6 Modern Developments in Industry

The module will provide insights in the core elements of Industry 4.0 such as: introduction to cyber-physical systems, Radio Frequency Identification (RFID) technologies, Manufacturing Execution System (MES) and other technology for order management, as well as production control and value adding to the complete supply chain management.

6.7 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.

7. Internship

8. Master Thesis

*__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.

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.

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.

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.

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.

TUMCREATE

TUMCREATE is a joint programme between the Technical University of Munich (TUM) and the Nanyang Technological University (NTU). The electromobility institute brings together the expertise and innovation of Germany and Singapore to drive innovation and shape the future of sustainable mobility by tackling issues ranging from molecules to the megacity. Graduates have the opportunity to apply for positions at TUMCREATE, especially if your interest lies in the area of transportation and mobility research.

Industry Outlook

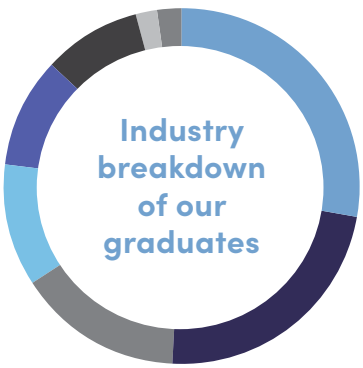
Did you know that **the core of the chemical industry is shifting to Asia by 2030?**

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



Chemical	28%
Academic	23%
Others	15%
Research	11%
Pharmaceutical and Medical	10%
Manufacturing	9%
Life Sciences	2%
Petrolchemical	2%

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

Processing Fee
SGD79 per application

Tuition Fee
SGD48,150+

Admission Criteria

- **Bachelor Degree** in **Chemical Engineering or Chemistry** or a closely related discipline
- Bachelor Degree certificate or enrolment letter* (if you have not completed your Bachelor Degree)
- Academic transcripts or mark sheets*
- **2 Recommendation Letters** from your professors or employers
- **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
- **Akademische Prüfstelle (APS) certificate** for applicants who hold a degree from China, Vietnam, or Mongolia

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

Applications open 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 1 January 2020. All fees are subject to revision due to currency fluctuations, at the discretion of TUM Asia. All fees quoted are inclusive of 7% Singapore's Government Goods & Services Tax (GST). Please refer to our website for fee updates.

* Documents which are not in English must be translated by a certified translator. All applicants are also required to submit an additional of
- 2 notarised copies of official or provisional Bachelor's Degree certificate
- 2 notarised copies of official academic transcript, and
- 2 passport-sized photographs when you have accepted the offer of admissions and are being matriculated into our programme.

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