TUM Asia

Master of Science
Industrial Chemistry

Technical University of Munich

NUS National University of Singapore

At A Glance

JOINT DEGREE BY
Technical University of Munich (TUM)
National University of Singapore (NUS)

TWO-YEAR FULL TIME PROGRAMME
Coursework in Singapore

PRACTICAL KNOWLEDGE
Compulsory Internship & Thesis

GLOBAL PROSPECTS
Internationally Recognized Degree

INTAKE
August Every Year

TO APPLY
Apply online from 15th October at www.tum-asia.edu.sg

1 TUM is ranked as the #1 University in Germany+

6 TUM ranked #6 in the Global Employability Survey^

17 17 scientists & alumni of TUM have received the Nobel Prize

50 Both TUM & NUS# are in the world's Top 50 Universities

Technical University of Munich (TUM)

Technical University of Munich (TUM) is one of Europe's leading research universities, with around 524 professors, 10,100 academic and non-academic staff, and more than 40,000 students. Its focus areas are the engineering sciences, natural sciences, life sciences and medicine, reinforced by schools of management and education.

TUM acts as an entrepreneurial university that promotes talents and creates value for society. In that it profits from having strong partners in science and industry. It is represented worldwide with a campus in Singapore as well as offices in Beijing, Brussels, Cairo, Mumbai, and São Paulo.

Nobel Prize winners and inventors such as Rudolf Diesel and Carl von Linde have done research at TUM. In 2006 and 2012 it won recognition as a German "Excellence University." In international rankings, TUM regularly places among the best universities in Germany.

TUM Asia

Through TUM's unwavering commitment to the betterment of society, TUM Asia was set up in 2002 as the first academic venture abroad by a German university. Today, TUM Asia offers standalone and joint Bachelor and Master programmes in Singapore together with partner universities such as National University of Singapore (NUS), Nanyang Technological University (NTU) and Singapore Institute of Technology (SIT).

A close cooperation with key industry players helps to ensure that the curriculum stays relevant and practical to the needs of the industry. Together with the unique combination of German engineering with Asian relevance, TUM Asia's graduates are equipped to enter both industry and research sectors on a global level. With over a decade of experience, TUM Asia continues to provide quality higher education programmes suited to the needs of the industry in Asia.

In 2015, over one thousand students have come through the doors of TUM Asia and currently ply their trades in top research institutes and companies across the globe.

Master of Science
Industrial Chemistry

TUM Asia's 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.

COURSE OUTLINE

12 **Modules to be completed**
(4 Core Modules, 3 Elective Modules, 4 Non-Technical Elective Modules and 1 Business & Technical English Module)

5 **Lab courses to be completed**
(1 Chemistry Lab Course and 4 Core Modules)

6 **Electives of your choice, with three specialisations:**
1) Catalysis and Petrochemistry
2) Building and Material Science
3) Interdisciplinary Combination

45 **Contact hours for every Core, Elective Module and Lab Course**

JOINT DEGREE
Conferred by Technical University of Munich (Germany) and National University of Singapore (Singapore)

APPLICATION-FOCUSED
Full-time research and application focused programme, inclusive of 3-month internship experience and 6-month Master Thesis writing

INDUSTRY RELEVANCE
Our professors are actively involved in research and cooperation projects with leading industrial companies, allowing them to base the curriculum around the latest technological trends and knowledge

GLOBAL OPPORTUNITIES
You are able to complete your Internship and Thesis in Singapore or anywhere in the world with a company, university or research institute and look for job opportunities globally

Programme Timeline Overview

July
Arrival in Singapore

Year 1
- Business & Technical English
- Core Modules
- Lab Modules
- Elective Modules

Year 2
- Elective Modules
- Internship
- Master Thesis at a company, university or research institute

(Supervised by a NUS or TUM professor)

Graduation
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.

Module Synopsis

1. Pre-essential Modules

1.1 Business and Technical English

The module aims to teach students the technical writing techniques and to familiarise them with the 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

2. 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 immobilization 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 characterization 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 polymerization 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; influence of process parameters on molecular mass distribution.

3. Specialization 1: Catalysis and Petrochemistry

3.1 Molecular and Heterogeneous Catalysis

Both homogeneous and heterogeneous catalysis will be described, and important applications will be exemplary 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 course 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 managing hydrogen, Basic Petrochemical Processes.

3.3 Unit Operations

The scope of the course module is to enable students to understand the principals 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, Reactor Technology. The course teaches the qualitative and quantitative basics engineering principles used to design and to operate mechanical, thermal, and chemical units of a process plant.

4. Specialization 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 lecture will give an overview of the physical properties and nanostructure of building materials, surface properties, corrosion processes, sol-gel process, solid state chemistry, geopolymers, and interactions on polymer – cement surface.

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, 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, characterization methods for materials at diverse scale, application of materials in building engineering.

4.3 High-Performance Polymers

The module covers the following topics: characterization 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 characterization methods.

5. Specialization 3: Interdisciplinary Combination

Student has to complete:

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

6. 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 with the final objective 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 the long-term financial structure.

6.2 Legal and Safety Aspects in the Industry

A brief description of the history of law, legal theories and importance for the commercial life. Development of the legal systems “common law” and “civil law”. Understanding of the common routes of both systems. Fundamental principles and differences between two legal systems, contract law and tort law. Basic principles of the UN Conventions for sales of goods, latest developments within the EU – legislation in respect of environmental and IT regulations.

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 nowadays ERP software packages (ERP = Enterprise Resource Planning). Concepts of material requirements planning, supply chain management (SCM) combined with basics in cost accounting will be explained.

6.4 Innovation and Technology Management

The lecture will cover the following topics: Innovation vs. invention, Creating value through innovation, Four forces of innovation, Value to the customer and Hi-Tech Marketing, Business system innovation and Service innovations, Technological discontinuities, S-Curves and Scenario techniques, Venture capital, Start-ups and financing of innovation, and more.

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 System, Radio Frequency Identification (RFID) technologies, Manufacturing Execution System (MES) and other technology for order management, 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 and 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 commercialization 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. TUM Asia reserves the right to cancel or postpone the module under such circumstances.*

Admissions Information

ADMISSION CRITERIA*

- You may apply to our programme if you have completed your Bachelor Degree Programme, or if you are in your final year of Bachelor Degree studies
- Hold or enrolled in a Bachelor Degree (completed in at least three years, depending on factors such as the rest of your education background) in **Chemical Engineering or Chemistry** or in a closely related discipline
- Submit one **(1) notarised copy of Bachelor Degree Certificate or Enrolment Letter**** (if you have not completed your Bachelor Degree) and **one (1) notarised copy of Academic Transcripts or Mark Sheets****
- Submit **two (2) Recommendation Letters** from two (2) different Professors or Employers
- Submit **one (1) Statement of Purpose** that indicates the reason(s) you are interested in the programme you applied for
- Submit **one (1) Curriculum Vitae / Resume**
- Submit TOEFL / IELTS test score taken no more than two years ago from date of submission of online application
- Submit Akademische Prüfstelle (APS) certificate (Required for applicants who hold a degree from China, Vietnam, or Mongolia)

TOEFL test score requirements: At least 88 for the Internet-Based Test (TOEFL code: 7368)
IELTS test score requirements: Overall IELTS results of at least 6.5

* The full application process is available on www.tum-asia.edu.sg/application-process.

** Documents which are not in English must be translated by a certified translator. All applicants are also required to submit an additional of three (3) notarised copies of Official or Provisional Bachelor Degree Certificate, two (2) notarised copies of full, Official Academic Transcript, and three (3) passport-sized photographs when you have accepted the offer of admissions and are being matriculated into our programme.

TO APPLY

Applications open 15 October every year. Apply online at www.tum-asia.edu.sg

FINANCING YOUR STUDIES

APPLICATION	TUITION FEE
SGD 79 is payable for each application per programme	**A total of SGD 48,150⁺** • The tuition fee will be divided into 3 installments for payment and may be further divided into SGD and EUR amounts. • The tuition fee includes teaching fees, laboratory expenses and cost of mandatory events. • The tuition fee does not include airfare, accommodation, living expenses, and NUS miscellaneous fees (inclusive of registration, IT facilities, matriculation, examination, amenities, copy right, sports, insurance and medical). These fees will be separately paid by the student.

⁺ The tuition fee stated is accurate as of 1 August 2018. 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. Please refer to our website for fee updates.

Studying With Us

"Talents Are Our Assets, Reputation Is Our Return"

Entrepreneurial Thinking and Engagement

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 vantage points, creating a capacity to solve problems in creative ways. The unique joint degree programme not only equips the student with technical and scientific knowledge, but with an enriched curriculum consisting of business and cultural modules.

"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
PhD Candidate, Spitzencluster Forum Organic Electronics

Highest International Standards

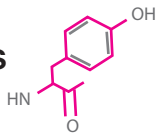
You will be studying with the world's best professors from TUM and NUS, as well as experts from the industry. Not only will the student benefit from professors who are actively involved in research, one will also receive a holistic learning experience with the engagement of local lecturers from academia and industry. Our TUM modules are covered by professors who fly in from Germany on an exclusive teaching basis, to ensure that students get the undivided attention of their lecturers.

"The Industrial Chemistry course provides compelling insight into important topics of modern applied chemistry. It helps students to gain knowledge and to improve their creativity, which is of utmost importance for the future development of both society and industry. It also provides a solid basis to build upon for leadership positions that take part in shaping our future."

Prof. Dr. Fritz E. Kühn
Professor, Technical University of Munich
Head of Molecular Catalysis

DID YOU KNOW THAT THE CORE OF THE CHEMICAL INDUSTRY IS SHIFTING TO ASIA BY 2030?

Jurong Island: Singapore's Dynamic Chemical Hub



Singapore's position as a global chemicals hub has grown with the extensive development of Jurong Island - an integrated complex housing many of the world's leading energy and chemical companies. Given Singapore's strong track record for intellectual property rights protection, the nation is ideal for companies seeking to develop and commercialise proprietary technologies and first class manufacturing processes.

Singapore aims to be a model of sustainable development by taking the lead to address climate change concerns and global resource constraints. Solutions involve energy efficiency, emissions management, and sustainable feedstocks and technologies. A number of high impact projects to utilize Singapore's integrated manufacturing location are being implemented.

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 the economic growth and today, almost half of the 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 chemical, such as the automotive, construction and pulp industries.

Additionally, considerably more than 50% of the worldwide building activities are taking place in Asia at the moment. Today, China alone produces 60% of the cement worldwide, followed by India. Besides building activities, both new constructions and renovations are partially associated with enormous increase in energy consumption, something which is in turn detrimental to energy efficiency and can be reduced by "intelligent materials". The construction industry is probably the most important industry in China and India. Even other Asian countries such as Vietnam and Thailand are experiencing a construction boom with significant growth rates and infrastructure. Therefore, tomorrow's chemical experts are required to be versatile strategists and should seize the opportunities that are lined up for the chemical industry in Asia.

Sources: A.T. Kearny, Inc., Singapore Economic Development Board

1 Singapore is one of the leading Energy and chemical hubs, while being home to some of the world's largest chemical plants.

2 Singapore's chemicals sector is a major employer, with employees having the highest skills and two times the remuneration among all manufacturing industries.

2 In the past two decades, the growth in the chemical industry has been driven by Asia.

3 Singapore has the third largest oil refinery in the world, behind Rotterdam and Houston.

10 Half of the top 10 chemical companies in the world will be Asian or Middle Eastern companies.

18 Singapore is the 18th largest exporter of oil in the world despite not having a single drop of oil reserves, exporting 1.374 million barrels per day and importing 1.195 million barrels per day.

35 Singapore's chemicals hub, Jurong Island, has successfully attracted investments in excess of S$50 billion.

66 From 2010 to 2030, sales in the chemical industry in Asia is expected to rise from 49% - 66%.

Our Graduates

Our graduates in Industrial Chemistry are employed all over the world, such as in **Singapore (48.7%), Europe (33.9%), China (8.7%).**

The most commonly accepted positions are **Chemist, Research Engineer, Project Engineer,** and **Research Scientist.**

TUM Asia has close relationships with many of its industry partners. Our graduates are expected to be able to find positions with many companies, such as **BASF, Clariant, DELO** and **Exxon Mobil.**

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All information is accurate at the time of printing and is subject to change without prior notice.
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+ As rated by Academic Ranking of World Universities (Shanghai Ranking) 2011-2013, 2016 and 2015-2018 QS World University Ranking
^ As ranked by the Global University Employability Ranking 2018
# As ranked by Academic Ranking of World Universities (Shanghai Ranking) 2017/2018 and 2013/2014 QS World University Ranking