

Master of Science Industrial Chemistry

TUM Asia

TUM
Technische Universität München

NUS
National University
of Singapore



At A Glance

JOINT DEGREE BY

Technische Universität München (TUM)
National University of Singapore (NUS)

20 MONTHS FULL TIME PROGRAMME

Coursework in Singapore

PRACTICAL KNOWLEDGE

Compulsory Internship & Thesis

GLOBAL PROSPECTS

Internationally Recognized Degree

INTAKE

August Every Year

TO APPLY

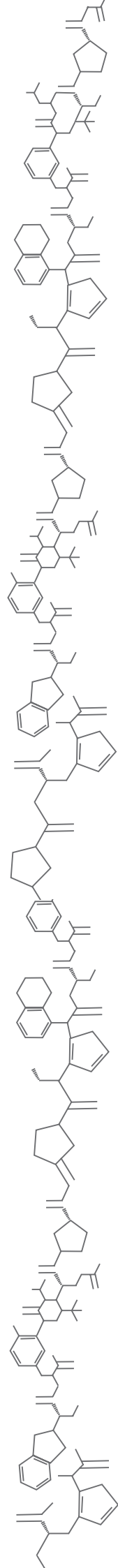
Apply online from 15th October at
www.tum-asia.edu.sg

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

11 TUM ranked #11
in the Global
Employability Survey[^]

13 TUM has produced
13 Nobel Laureates

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





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.

Technische Universität München (TUM)

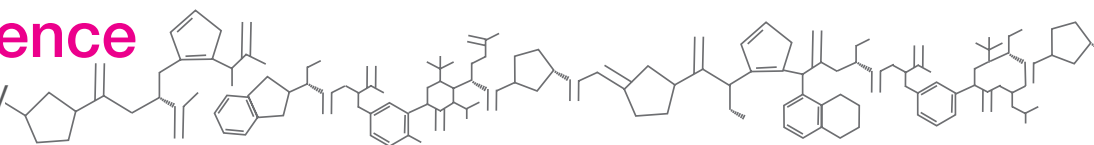
Technische Universität München (TUM) is one of Europe's leading research universities, with around 500 professors, 10,000 academic and non-academic staff, and more than 37,000 students. Its focus areas are the engineering sciences, natural sciences, life sciences and medicine, reinforced by schools of 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.

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.



JOINT DEGREE

Conferred by Technische Universität München (Germany) and National University of Singapore (Singapore)



3 SEMESTERS

Full-time research and application focused programme, inclusive of internship experience and 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 Munich, Singapore or anywhere in the world, to look for job opportunities globally

COURSE OUTLINE

14

The student has to complete 14 modules in 2 semesters

(4 Core Modules, 6 Elective Modules, 1 Business & Technical English Module, & 3 Cross Discipline Modules)

6

Electives of your choice, with three specialisations: 1) **Petroleum and Petrochemistry**, 2) **Biochemistry**, or 3) **Module Combination** of your choice

45

Contact hours for every Core, Elective Module and Lab Course

Duration of the Programme: 20 months

August



Arrival in Singapore

5 Months



- Business & Technical English
 - Core Modules
- Lab Modules
 - Cross Discipline Modules

6 Months



- Elective Modules
- Lab Modules
 - Cross Discipline Modules

3 Months



Internship

6 Months



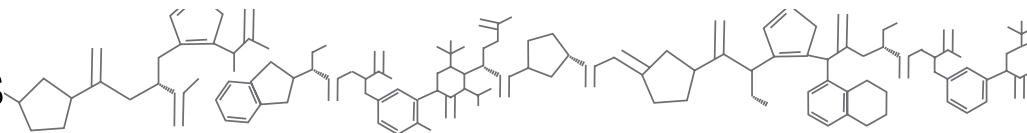
Master Thesis at NUS, TUM or a Company

Graduation



End of Programme

Module Synopsis



Core Modules (*Comes With Practical)

Organo-Metallic and Coordination Chemistry*

Bioorganic Chemistry*

Chemical Reaction Engineering*

Chemical Business Administration

Elective Modules* (Choose one area of specialization)

Specialisation 1: Petroleum and Petrochemistry

Molecular and Heterogeneous Catalysis

The goal of this module is to provide insight into the important field of 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.

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.

The course teaches the chemical and engineering basics underlying the processing options and processes. The student should be able to understand the options and limits of adjusting reaction conditions and to develop improved or alternative reaction routes. The insight into these chemical and engineering aspects should help to understand the complexity of the processes in the two areas and the options for designing the appropriate interface between a petroleum complex and the making of basic petrochemicals.

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. The student will be able to understand the basic layout of these units and to quantitatively predict the performance of these units. This will help to understand the applicability, potential, and limitations of different unit operations.

Specialisation 2: Biochemistry

Biochemistry for Industrial Chemists

This module is specifically designed to provide students with fundamentals on biochemistry required for a wide range of (industrial) applications in bioscience and biomedicine. Selected topics are gene regulation, protein expression and physiological metabolism in cellular reactions, structural aspects to gain insight into drug design and assay development for pharmaceutical applications. The module includes the structural and functional properties of DNA, proteins and interactions between molecules. An emphasis on gene regulation will lead to the understanding of metabolic processes and proteomics (from genomics to proteomics). Also, the pathogenesis of diseases related to the malfunction of genes and proteins will be addressed – and major developments in recent biomedicine research.

Cell Biology

More advanced applications in biochemistry are the main objectives of this module. The course will cover the organisation of living cells with respect to using cells for induced bio reactions and

applications in biotechnology. The communication and reaction of cells to extra- and intracellular signals will be discussed.

Understanding the organisation of cells, from a single to a multi-cellular organism, gives insight into one of the most complex and fascinating networks alive. This module focuses on the compartmentalisation of cellular organisms, the complex reactions in genetics and protein biochemistry, the highly organised metabolic reactions and the pathology occurring when parts of this network fail. Within the cell are transport processes, feedback loops, sensing interfaces, membrane compartments and gradients over membranes. Altogether they allow a cell not only to grow, divide and communicate with its environment, but also to adapt to changes in the environment and to evolve. If such complex processes malfunction, oncogene may cope for tumor development and thus immunological reactions within an organism start to fight back. Today, scientists know that the crosstalk between the immune, hormone and nervous system plays an important role for tissue homeostasis. Pharmaceutical research focuses on such reactions to develop innovative drugs for cancer therapy or to fight diseases like AIDS or neurodegenerative diseases (Morbus Alzheimer, Morbus Parkinson etc.). This research could be addressed as “from bench to screening” or “from bench to drugs”. This module will also cover the biological features of adult and embryonic stem cells since they provide a great means to develop disease models and individualised drugs.

Bioprocessing / Bioengineering

In this module, biotechnological and process engineering principles will be introduced with a specific emphasis on industrial and pharmaceutical applications. The modifications of organisms like bacteria, yeast, insect or human cells provide the possibility to produce large amounts of recombinant proteins for biological or medical applications. Since enzymes are widely used in industrial and medical applications, it is crucial to understand enzyme kinetics and bioprocessing techniques for the production of such proteins. The latest techniques for the modification of organisms (modifications on the genomic/transcriptional or proteomic/translational level) will be introduced as well as scale-up and scale-out technologies, drug handling, analysis and (cryo-) conservation. Bioreactor technology provides the tools required for production processes under GLP conditions and assures a high reproducibility and quality of a product. Modern (bio-) analytical techniques will be discussed since they are important to validate samples and to characterise target molecules. Among these techniques are Mass Spectroscopy, NMR, X-ray crystallography, Spectroscopic and Fluorescent assays.

Specialisation 3: General

- One Module From Specialisation 1
- One Module From Specialisation 2
- One Module From Specialisation 1, 2 or Elective Modules*

Additional Elective Modules* (Choose 3 modules)

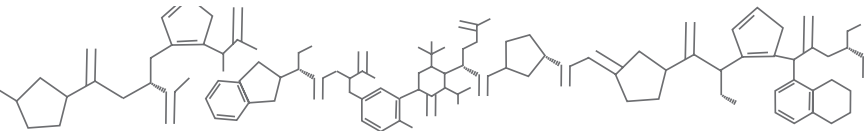
- Building Chemistry and Construction Chemicals
- Water Chemistry & Industrial Requirements
- Industrial Chemistry Marketing
- Production Planning in Chemical Industry
- Material Chemistry and Engineering

A list of modules offered by the Department of Chemistry and the Department of Chemical & Biomolecular Engineering of NUS will be made available to the students before the start of the semester. The list of available modules is subject to change.

Cross Discipline Modules

- Legal Aspects in Chemical Industry
- International Intellectual Property Law
- Choice of 1 Cross-Discipline Module offered in TUM Asia MSc programmes

*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.



ADMISSION CRITERIA*

- Hold a minimum 3-year Bachelor Degree in Chemical Engineering, Chemistry, or equivalent degree in other relevant disciplines
- Submit **one (1) notarised copy of Official or Provisional Bachelor Degree Certificate**** and **one (1) notarised copy of Official or Provisional Academic Transcript****
- Submit **two (2) Recommendation Letters** from two (2) different Professors or Employers
- Submit **one (1) A4-page Letter of Motivation** that indicates the reason(s) you are interested in the programme you applied for
- Submit **one (1) Curriculum Vitae / Resume**
- Submit **one (1) Passport-sized photograph**** and **one (1) Passport Biodata Page photocopy** (the passport page with your personal particulars)
- **TOEFL / IELTS** (Required for applicants whose native tongue or medium of instruction from previous studies is **not in English**)
- **Akademische Prüfstelle (APS) certificate** (Required for applicants who hold a degree from **China, Vietnam, or Mongolia**)

TOEFL Requirements: Minimum 605 for the Paper-Based test / 234 for the Computer-Based test / 88 for the Internet-Based Test
IELTS Requirements: Overall IELTS results of at least 6.5

Important: Documents that are not in English must be translated by a certified translator

* Find out about the full application process on www.tum-asia.edu.sg/application-process

** All applicants are required to submit an additional of three (3) notarised copies of Official or Provisional Bachelor Degree Certificate, three (3) 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 15th October. Apply online at www.tum-asia.edu.sg.

TUITION FEES

APPLICATION FEE

S\$79 (inclusive of GST) or **Euro 52** is payable for each application per programme

PAYMENT OF TUITION FEES

A Total of SGD 48,150* (Actual fee split into SGD and EURO)

Tuition fees includes teaching fees, examination fees, internet access on campus, laboratory expenses and cost of mandatory events. Expenses excluded from this fee and are to be borne by students include: airfare, accommodation, and living expenses. The tuition fee will be paid in 3 installments.

* Tuition fees are accurate as of 1 October 2016. Tuition fees are subject to revision due to currency fluctuations, at the discretion of TUM Asia. Fees quoted are inclusive of 7% Singapore's Government Goods & Services Tax. Please refer to www.tum-asia.edu.sg/MScfees for the latest tuition fees.





Studying at the Technische Universität München Asia

“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 20 month joint degree equips the student with not only technical and scientific knowledge, but with an enriched curriculum composed of business and cultural modules.

TUM CREATE - Centre for Electromobility

TUM is known for its research capabilities and strength in innovation. As such, TUM Asia spearheaded the set up of TUM CREATE as a base of research in Singapore. TUM Create is a joint programme between Technische Universität München (TUM) and Nanyang Technological University (NTU). The electromobility institute brings together the expertise and innovation of Germany and Singapore, to drive innovation to shape the future of sustainable mobility by tackling issues ranging from the molecules to the megacity. **Graduates from the TUM Asia Master programmes have the opportunity to apply for positions at TUM Create, especially if your interest lies in research/electromobility.**

Highest International Standards

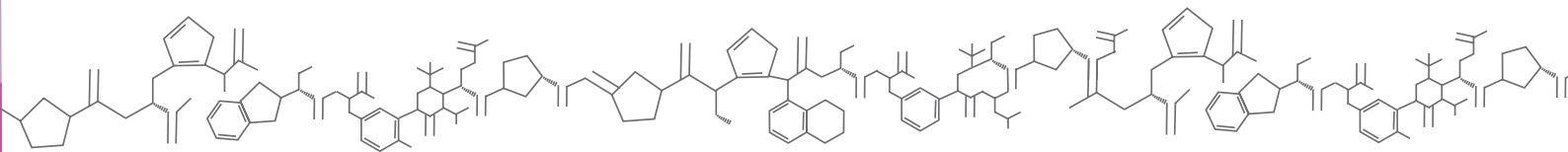
You will be studying with the world's best professors from TUM and NUS, as well as experts from the industry. Not only will the student benefit from professors who are actively involved in research, one will also receive a holistic learning experience with the engagement of local lecturers from academia 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.

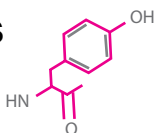
Prof. Dr. Fritz E. Kühn

Professor at Technische Universität München,
Head of Molecular Catalysis, TUM

DID YOU KNOW THAT SINGAPORE'S PETROCHEMICALS INDUSTRY AND OIL REFINERY IS ONE OF THE LARGEST IN THE WORLD?



Jurong Island: Singapore's Dynamic Chemical Hub



Singapore's position as a global chemicals hub has grown in tandem 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.

The Chemical Industry in Singapore

As one of the world's leading energy and chemical industry hubs, Singapore's contribution to the industry is vast in terms of output and research. Mega growth trends like rapid urbanization, changing demographics and the rise of the Asian middle-class are shifting demand to Asia. Singapore is constantly working to stay at the forefront of the industry's advancement, with the chemical and chemical products sector contributing S\$38 million of the manufacturing output in 2010.

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, and Evonik**

1

In Singapore, the Petrochemical industry is one of the fastest growing industries, with strong linkages to the petroleum refining industry

2

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

3

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

12

From 2009 to 2012, the high value-added speciality chemical segment grew with an average of 12% per year

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 / day and importing 1.195 million barrels / day

35

Presently, Singapore's chemical hub, Jurong Island, has successfully attracted investments in excess of S\$35 billion

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 Student, Spitzencluster Forum Organic Electronics

Partnering with highly qualified institutions such as TUM Asia puts us in touch with the talent of the future and gives these talented students the opportunity to drive innovation.

Clariant (Singapore) Pte. Ltd.

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German Institute of Science & Technology - TUM Asia Pte Ltd

CPE Registration No.: 200105229R

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All information is accurate at the time of printing and is subject to change without prior notice.

Published in October 2016.

⁺ As rated by Academic Ranking of World Universities (Shanghai Ranking) 2011-2013, 2016 and 2015 QS World University Ranking

[^] As ranked in the 2015 Global Employability Survey by The New York Times

[#] As ranked by Academic Ranking of World Universities (Shanghai Ranking) 2013 and 2013/2014 QS World University Ranking