Introduction of the School

The School of Chemical and Biomedical Engineering (SCBE) at Nanyang Technological University (NTU) aims to empower a new generation of engineers through a rigorous curriculum that integrates principles of engineering with fundamentals of life and chemical sciences.

With its dynamic faculty from internationally renowned universities, modern infrastructure and state-of-the-art research and teaching facilities, the School provides a stimulating learning environment and opportunities for students to identify and pursue personal and professional goals.

The School aims to provide educational experiences that facilitate students to gain a thorough understanding of the fundamentals of life and chemical sciences.

About Bioengineering

Bioengineering is a fusion between the various disciplines of engineering and Biomedical Sciences.

Engineering plays a key role in Biomedical Sciences (BMS). The two fields are complementary, as core technologies from different Engineering disciplines are applied in several BMS areas. In fact, BMS has led Engineering to evolve further into areas such as Biomedical Imaging, Biomedical Instrumentation, and Biomaterials and Tissue Engineering, which can be broadly classified under the spectrum of “Bioengineering”.

A Bioengineer applies fundamental principals and methods of Engineering to address problems in medical and life sciences. Although the main Bioengineering endeavour is based on Engineering disciplines, a Bioengineer also needs a good background in biological and medical sciences.

How did Bioengineering evolve?
The recent progress made in molecular biological sciences has greatly advanced the fields of genetics, molecular and cell biology. These achievements have opened up new Engineering approaches to develop new technologies and to solve biomedical problems, with the ultimate aim of diagnosing and curing diseases and advancing healthcare.

Broad Coverage of Areas and Applications in Bioengineering
- Biosignal Processing (e.g. electrocardiography to detect irregular heartbeats)
- Biomedical Instrumentation (e.g. pacemaker to regulate heart frequency by electrical stimulation)
- Medical Imaging (e.g. ultra-sound 3D colour image to examine the health and position of an unborn foetus)
- Tissue Engineering (e.g. artificial skin)
- Biomaterials (e.g. bioactive bone substitute)
- Biomechanics (e.g. quantitative diagnosis of injured limbs)
- Artificial Organs (e.g. left ventricular assist devices)
- Orthopaedic Implants (e.g. artificial hip joints)
- Biochemical Processing (e.g. reactors using microbes to produce drugs)
- Nanotechnology (e.g. developing nano-sized devices to help eradicate harmful tissues and cells)

Our teaching and training objectives are to:
- Nurture a new generation of engineers by providing students with a strong foundation in mathematics, physical sciences, molecular and cell biology as well as in the fundamental principles and methods of engineering.
- Cultivate the entrepreneurship spirit among students by creating opportunities for students to innovate new technologies and develop solutions for biomedical problems, with the ultimate aim of advancing healthcare through better disease prevention, diagnosis and treatment.
- Inculcate social responsibility with an appreciation of ethics in bioengineering and obligation as professional bioengineers to society.
Bioengineering Programme

The School offers a four-year undergraduate degree programme in Bioengineering (BIE). Upon graduation, successful students will be awarded direct honours. The programme blends modern biological principles with advanced engineering methods in electronics, materials, mechanics and computing to train high standard engineers for biomedical and biotechnology industries as well as healthcare and clinical services.

The SCBE Bioengineering programme has been revamped, and it is 86% similar to the biomedical/bioengineering/biological engineering programmes offered by the top 5 American universities (Massachusetts Institute of Technology, Johns Hopkins University, Georgia Institute of Technology, University of San Diego) in biomedical/bioengineering/biological engineering fields. The new curriculum aims to meet the needs of the biomedical industry in Singapore and better prepare our graduates for immediate employment in the healthcare industry, especially in medical devices, regulatory affairs and hospitals.

In the lecture modules, we concentrate on applying knowledge to innovations in healthcare with a focus on entrepreneurship. In the design module, such as Design Project and Management, we introduce a Medical Device Design tailored to look specifically into design aspects in medical devices. New labs sessions such as bioimaging (CT and MRI), for the first time, students can have hands on experience. We also offer a Hospital Attachment elective to give our students the opportunity to work directly with clinicians. Our commitment to our students ensures that we continuously evolve by providing a balanced programme in depth and breath through free electives, which will better prepare our graduates for the rigorous demands of today’s bioengineering industry.

Accreditation
The degree programme in Bioengineering is accredited by the Engineering Accreditation Board (EAB) of the Institution of Engineers Singapore (IES).

Students can solve challenging problems in biomedical engineering and its related areas and better understand the implications of these solutions on society

Unique Features
- Strong foundation in both engineering and biomedical principles.
- Rigorous training in systematic problem solving skills.
- Multi-disciplinary training in emerging bioengineering areas.
- Good manufacturing practice (GMP) training for engineers in biomedical and biotechnology industries.
- Solid science foundation for medical and advanced research programmes.
- Industrial attachment—Valuable experience either at local or overseas firms in bioengineering related industries or R&D.
- Global Immersion Programme (GIP)—Opportunities for six-month stints in one or more of the following countries: China, India, France, Switzerland and USA.
- Accelerated Bachelors Programme (ABP)—Fast track programme to enable the completion of an undergraduate degree in three and a half years.
- Undergraduate Research on Campus (URECA) programme*—Opportunities for research attachments within NTU.

* Students need to fulfill certain requirements to be eligible for these special programmes offered by NTU.

Key Features of Bioengineering @ NTU
1. Hospital Attachment
2. Biomedical Design and Regulatory Module
3. Entrepreneurships

In addition to satisfying the general entry requirements of NTU, candidates seeking admission to the BIE undergraduate programme must have a minimum of H2 level (or equivalent) passes in mathematics and biology/chemistry/physics/physical sciences and a GCE ‘O’ Level (or equivalent) pass in physics. An ‘O’ level (or equivalent) pass in physics is only applicable to candidates without H2 level (or equivalent) pass in physics.

Candidates with relevant diplomas from local polytechnics may apply for admission. Eligible candidates who hold a diploma with merit/distinction may be considered for direct entry into the second year* of the programme (i.e. completion of the programme in three years). Other eligible candidates may be admitted into the first year with exemption of courses granted on a case-by-case basis.

* Only applicable to candidates who are applying for admission in Academic Year 2012/13 and onwards.

Admission Requirements

Students will develop good communication and management skills through team work in the execution of experimental and design projects.
Overview of the Curriculum

The unique NTU BIE curriculum focuses on the following three main areas:
- Biomedical imaging
- Bioinstrumentations and Bioelectronics
- Biomaterials and Tissue Engineering

Year 1
Foundation courses
- Introduction
- Bioengineering Fundamentals
- Physics and Materials
- Engineering mathematics

Year 2&3
Principles of Bioengineering
- Molecular Cell Biology for biomedical engineering
- Computational Methods in Biomedical Engineering
- Cardiovascular Engineering
- Thermodynamics
- Biomedical Electronics
- Biomechanics
- Biocomputing

Year 4
Electives/ Specialisation
- Bioinstrumentations and Bioelectronics
- Biomaterials and Tissue Engineering
- Final Year Design Project
- Medical Device Design

Facilities

The School is housed in two buildings totaling 30,000 square meters, providing learning experiences essential to a first-rate education in chemical and biomedical engineering. The buildings are designed with ample room to conduct lectures and tutorials in seminar style, undergraduate laboratory work and postgraduate research. By every measure, the facilities are set to emphasize a quality learning environment—from state-of-the-art laboratory equipment and our high-tech teaching stations to aesthetically soothing interior design that is conducive for learning and research.
The biomedical engineering and sciences sector has seen a healthy growth and is slated to be a key engine of future growth in Singapore. In the recent five years, Singapore has invested approximately $2 billion in biomedical industry and institutions. Graduates that are proficient in both engineering and biomedical sciences can find attractive opportunities in pharmaceutical industries, a range of research institutes, hospitals and organisations that deal with biomedical instruments, medical devices, biomaterials, drug discoveries and other related industries. Specifically, they may find jobs in companies such as Agilent Technologies, GE Medical, Siemens Medical Instruments, Attogenix Biosystems, and WelchAllyn International; research institutions such as Institute of Bioengineering and Nanotechnology, Institute of Molecular and Cellular Biology, Bioinformatics Institute; hospitals such as Singapore General Hospital, National University Hospital; or they may continue their study in medical schools or top Ph.D. programmes around the world.
SCBE Club
The SCBE Club was first established in 2004, underpinned by fundamental ideals in supporting a cohesive community for the SCBE family. As of AY12/13, the SCBE Club sees its 8th Management Committee.

The support and flexibility from SCBE have not only led me to academic achievements in Bioengineering but also allowed me to explore many other non-engineering ventures. Thanks to this, my years in NTU have been a vibrant and wholesome voyage.

Alvin Koh
BIE Year 4

SCBE offers a comprehensive BioEngineering (BIE) program with a diverse and impressive range of teaching facilities, such as cell culture lab, computer labs equipped with sophisticated engineering software, and microfluidics clean room. I am definitely fortunate to land myself on an undergraduate journey in BIE. You would love the BIE culture; you would actually meet friendly professors directly mentoring the undergraduate students in their studies and research.

Jeanny Putri Haliman
BIE year 4

Teoh Swee Hin
Professor
A gentleman who has a passion for teaching and has received numerous Excellent Teaching awards. Professor Teoh Swee Hin’s main research interests are in Biomaterials and Tissue Engineering. His pioneering work in scaffolds technology for bone tissue engineering focusing on the study of mechanisms that promote cells growth incorporating numerous interdisciplinary fields including stem cells and bioreactors technologies and translating his research into early clinical applications. Prof Teoh guided Osteopore International to obtain FDA approval and CE mark for bone scaffolds in the craniomaxillary indications. The scaffolds have now been implanted successfully in more than 1500 patients. He is one of a few experts who teaches regulatory affairs in medical devices, and cGMP manufacturing.

Dong-An Wang
Associate Professor
Dr. Dong-An Wang is an Associate Professor of Bioengineering in SCBE, NTU. His research focuses on engineered regenerative medicine in cartilage and bones with specialties of biomaterials, gene therapy, and stem cells technology. As a major author, Dr. Wang has authored nearly a hundred publications and numerous disclosures for patent applications. Dr. Wang has served as an invited guest editor of Theme issues in top scientific journals. Dr. Wang was conferred with a Nanyang Award of Excellence in Teaching (2008) by NTU and a Best Paper Award (2011) by Elsevier and European Federation for Pharmaceutical Sciences. Dr. Wang currently serves as an Associate Chair in charge of Graduate Studies in SCBE, NTU.

Sierin Lim
Assistant Professor
Approachable and engaging, Assistant Professor Sierin Lim, she believes that curiosity is the main driving force in a successful learning inside and outside of the classroom. She encourages learning beyond the classroom by providing ample opportunities to students who are interested in protein engineering for applications in medicine and electronics to learn first-hand in her lab. She has been the Singapore recipient of the Asia Pacific Research Networking Fellowship from the International Federation of Medical and Biological Engineering 2012.

Visiting Professors
James M. ANDERSON (PhD Oregon State University)
Richard Ian KITNEY (PhD Electrical Engineering—Imperial College)

Faculty
CHAN, Julian Chi Chiu (PhD Hong Kong Polytechnic University)  
CHEN, Peng (PhD University of Missouri-Columbia)  
Chong Seow Khoon, Mark (PhD National University of Singapore)  
DUAN, Hongwei (PhD Max Planck Inst of Colloids & Interfaces)  
HUANG, Ling (PhD Nanjing University)  
KANG, Yuejun (PhD Vanderbilt University)  
KIM, Richie Donghyun (PhD University of Michigan)  
LEE, Kijoon (PhD Brown University)  
LIM, Sierin (PhD University of California, Los Angeles)  
LIU, Quan (PhD University of Wisconsin-Madison)  
LUO, Kathy Qian (PhD University of British Columbia)  
POH, Chuan Loo (PhD University of London, Imperial College)  
SONG, Hao (PhD The University of Houston)  
TEOH, Swee Hin (PhD Monash University)  
WANG, Dongan (PhD Zhejiang University)  
XU Chenjie (PhD Brown University)