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Introduction

We have prepared this booklet to assist candidates in their applications for admission to the Doctor of Philosophy and Master of Engineering programmes in the Faculty of Engineering. The information found here is for applicants applying for admission to the August 2016 Intake and January 2017 Intake (Session 2016-2017).

In this booklet, you will be introduced to the Republic of Singapore and the National University of Singapore, in case you are not a local resident. The individual departments in the Faculty of Engineering will also be featured.

The University has a very vibrant research environment. Our R&D activities have contributed significantly towards increasing Singapore’s stature in the scientific world.

About Singapore

Singapore is a small country situated at the southern tip of the Malaysian peninsula, just above the equator. The climate here is like summer all year round. Rain falls throughout the year, with more consistent rain coming during the monsoon season from November to January. Showers are usually sudden and heavy, but also brief and refreshing. Singapore’s climate is warm and humid, with only slight variations between the average maximum of 31 degrees Celsius and minimum of 23 degrees Celsius.

The population of Singapore is about 5.4 million, made up mainly of people of Chinese (74%), Malay (13%) and Indian (9%) origins. The four official languages spoken on the island are Mandarin, Malay, Tamil and English. The national language of Singapore is Malay while English is the language of administration and business, and is widely spoken and understood. Most Singaporeans are bilingual, and speak their mother tongue as well as English.

Strategic location, coupled with a small but dynamic population, has enabled the country to experience rapid economic development. Many factors (such as political and social stability, good international communications and transportation, infrastructure and an English-speaking skilled workforce) have attracted foreign investments and multi-national corporations to Singapore. Singapore is also a regional centre for business and technical consultancy, professional, engineering and computer services, and research and development activities.

The rich cultural heritage of Singapore has also made her a strong attraction to tourists from all parts of the world. Singapore is known as a shopper’s paradise - you can find a full range from arts and crafts, antiques, electronic goods, computer software to fashion. Singapore will offer visitors a culinary experience of a lifetime - distinctive dishes from the Chinese, Malay, Indian, Indonesian, Nonya, Japanese, Korean, Vietnamese, Thai, Filipino and Western culture can all be sampled here. Restaurants can be found alongside the ubiquitous hawker centres around the island.
The National University of Singapore operates from 3 campuses - Kent Ridge, Bukit Timah and Outram. Kent Ridge Campus occupies approximately 150 hectares of land and overlooks the western coast of Singapore, while Bukit Timah Campus, located near the centre of Singapore island, occupies 5 hectares of land and offers the perfect garden/park campus. The 2.4 hectares Outram campus is an integration of clinical service, teaching and research in a holistic patient-centric ‘medipolis’.

The University was inaugurated when the University of Singapore and Nanyang University merged to form one University on 8 August 1980. The University of Singapore’s roots date all the way back to 1905 when the King Edward VII College of Medicine was established.

Our multi-campus approach provides a broad-based curriculum underscored by multidisciplinary courses and cross faculty enrichment. NUS’ transformative education includes programmes such as student exchange, entrepreneurial internships at NUS Overseas Colleges, and double degree and joint degree programmes with some of the world’s top universities, offering students opportunities and challenges to realise their potential. The learning experience is complemented by a vibrant residential life with avenues for artistic, cultural and sporting pursuits. Over 37,000 students from 100 countries further enrich the community with their diverse social and cultural perspectives.

Vision and Mission

Vision
Towards a Global Knowledge Enterprise – A leading global university centred in Asia, influencing the future

Mission
To transform the way people think and do things through education, research and service

Faculties and Schools

It has 16 faculties offering undergraduate and graduate programmes. Currently, it has seven overseas colleges at major entrepreneurial hubs in Silicon Valley, Bio Valley, Shanghai, Beijing, Stockholm, Israel and India.

Student Population

The student population (as at September 2014) was some 27,975 undergraduates and 9,997 graduate students. Of the foreign student population, the majority are from the neighbouring ASEAN countries, although there are also significant numbers from the People’s Republic of China, South Asia and Europe.

Teaching and Research

The University strives to inspire a love for learning and achievement that extend beyond the campus, both in teaching and research programmes. The University has 3 Research Centres of Excellence and 26 university-level research institutes and centres.

At the University, it is believed that a personalised approach to teaching should be adopted. As such, tutorial classes are kept small to allow students ample opportunity for participative and independent learning. A lot of emphasis is placed on the teaching of fundamentals and their applications to real life problems. This is done so as to encourage students to be more creative, analytical and innovative. To enhance the quality and range of teaching, Information Technology (IT) is widely used.
Research is vigorously promoted in the University, supporting the national policy of developing a high technology and knowledge intensive economy. The University is achieving excellent results and recognition for its research both in Asia and the world. These research results find their way into commercial applications in industry through a proactive policy of actively searching for partners in industry.

Facilities Available on campus

The University’s campus has a wide range of facilities available. The National University of Singapore Libraries are a group of multi-disciplinary libraries which comprise seven libraries located across the Kent Ridge campus: 1) Central Library, 2) Chinese Library, 3) C J Koh Law Library (Bukit Timah Campus), 4) Hon Sui Sen Memorial Library, 5) Medical Library, 6) Science Library and 7) Music Library.

The Computer Centre spearheads the development of an IT-intensive environment on campus and provides a comprehensive computing and networking infrastructure to enable the University community to fully exploit IT for effective teaching, learning, research and administration.

The Sports & Recreation Centre provides both outdoor and indoor facilities. The outdoor facilities include an Olympic-sized swimming pool, eight-lane running track, multi-purpose field, tennis courts, basketball courts, netball courts and others. The indoor facilities include a competition hall, gymnasium, multi-purpose hall, squash courts, and an indoor rock climbing wall.

The NUS Degree

Students, after graduation, will find that their degree is a key that unlocks numerous opportunities. The NUS degree is much sought after by industry, particularly multi-national corporations. Graduates will, therefore, not encounter much difficulty in finding a rewarding job. Singapore needs well-trained people and welcomes people of all nationalities. A majority of foreign students look for jobs here after obtaining their degrees and stay on in this country.

Website

For further information regarding the National University of Singapore, you may wish to visit our website at: http://www.nus.edu.sg

Faculty of Engineering

Faculty’s vision:
“A leading Engineering School that innovates for a better future.”

The Faculty of Engineering’s mission is to nurture Engineer-Leaders and to address global challenges through Research, Innovation, Inspiration and Influence. Established in 1968, the Faculty of Engineering has contributed substantially to the rapid industrial and economic growth of the nation while continuing to contribute to a knowledge-based economy.

The Faculty comprises eight departments/divisions, namely: Biomedical Engineering, Chemical & Biomolecular Engineering, Civil and Environmental Engineering, Electrical & Computer Engineering, Engineering & Technology Management, Industrial & Systems Engineering, Materials Science & Engineering and Mechanical Engineering.
Graduate Education

The Faculty of Engineering is committed to the pursuit of academic excellence in a vibrant research community actively engaged in the global exchange of ideas and the pursuit of innovation. The graduate experience helps students realize their full potential and prepare them for an increasingly borderless and innovation-driven global economy.

We believe it is just as important to infuse our students with a spirit of enterprise and the mindset needed to thrive in an ever-changing global landscape. Our scholars have opportunities to learn from the best minds, not just in Singapore but beyond, because of our strong global partnerships with US Naval Postgraduate School, Monterey; French Grandes Ecoles; Technische Universiteit Eindhoven (TU/e), and Indian Institute of Technology Bombay/Kanpur/Madras (IITs India).

Apart from benefiting from an international exchange of ideas with a vibrant community of international faculty and students, prospective graduate students will discover a mosaic of graduate programmes – Master of Engineering and Doctor of Philosophy as well as several Joint programmes with renowned international universities – covering various engineering disciplines to meet their areas of interests and needs.

Research Programmes

The Faculty has built a comprehensive research infrastructure with top-notch facilities for carrying out cutting-edge research and strives to provide graduate students with facilities and an environment that are conducive to the pursuit of creative research.

Graduate students have the opportunity to work closely with faculty members on a wide variety of exciting research projects. Excellent opportunities are available for students to be immersed in a vibrant research-intensive environment in the following departments/divisions:

- Department of Biomedical Engineering
- Department of Chemical & Biomolecular Engineering
- Department of Civil and Environmental Engineering
- Department of Electrical & Computer Engineering
- Division of Engineering & Technology Management
- Department of Industrial & Systems Engineering
- Department of Materials Science & Engineering
- Department of Mechanical Engineering

or be attached to one of the Research Institutes/Centres, in the pursuit of a higher degree leading to:

- Doctor of Philosophy (Ph.D.)
- Master of Engineering (M.Eng.)

These higher degrees are awarded based on coursework and supervised research on an approved topic, culminating in the submission of a thesis.

Eligibility for Application

NUS Faculty of Engineering offers admission to research applicants who appear to have the highest potential for graduate study and who are most likely to contribute substantially to their academic or professional community in the future.

Admission decisions are based on an admissions panel comprising senior representatives from all engineering departments using a combination of factors including academic qualifications, proficiency test scores, evidence of research ability (e.g. published papers) and an interview to assess a candidate’s
communication and technical skills and suitability to pursue graduate research. Candidates with good TOEFL/IELTS and GATE/GRE test scores have an added advantage. In addition, NUS also considers the appropriateness of applicant’s goals to the graduate programme in which the applicant is interested and to the research interests of the faculty’s programme as well.

Satisfying minimal standards, however, does not guarantee your admission, since the number of qualified applicants far exceeds the number of places available. As a result, many well-qualified applicants cannot be accommodated.

The minimum requirement for admission is a Bachelor’s Degree with Honours (at least 2nd Class Lower) or its equivalent.

Applicants who are applying for the Ph.D. programme or NUS Research Scholarship are expected to have at least a Bachelor’s Degree with Honours (at least 2nd Class Upper) or its equivalent.

**IMPORTANT NOTE**
Candidates with a good Bachelors degree may apply for direct admission to the PhD programme. Do note that priority for the competitive NUS Research Scholarship will be given to applicants for the PhD programme over those applying to the MEng programme.

**Joint Programmes**
The Faculty has created exciting opportunities for students to embark upon joint programmes to broaden students' minds and enrich their educational experience, with immersion in a different school that, like NUS, emphasizes a culture of excellence.

**NUS-TU/e Joint Ph.D. Programme**
The NUS-Eindhoven University of Technology (TU/e) Joint Ph.D. programme is a synergy of two excellent study programmes. It is open to candidates with a good bachelor’s Degree (at least 2nd Class Upper Honours) or its equivalent. Candidates would spend at least 2 semesters of their candidature each at NUS and TU/e, either reading modules and / or undertaking research. For further details, please peruse the website at: [http://www.gse.nus.edu.sg/tue.html](http://www.gse.nus.edu.sg/tue.html)

**NUS-IITB Joint Ph.D. Programme**
The Indian Institute of Technology, Bombay (IITB) is well known around the world as one of the centres of academic excellence in the country. The Joint Doctoral programme will be offered by the Faculty of Engineering at NUS and the Indian Institute of Technology Bombay (IITB).

Applications for the Joint Ph.D. programme should be submitted to either NUS or IITB whichever is the university the candidate wishes to be registered with as their home university. The minimum admission criteria is at least a relevant Bachelor’s degree with Honours (at least 2nd Class Upper) or its equivalent.

Candidates who are interested in pursuing graduate studies in the NUS-IITB Joint PhD programme are welcome to visit the website at [http://www.gse.nus.edu.sg/NUS-IITB.html](http://www.gse.nus.edu.sg/NUS-IITB.html)

**NUS-IITM Joint Ph.D. Programme**
Another joint programme we have with a renowned IIT is NUS-IITM Joint Ph.D. programme. The Indian Institute of Technology, Madras is yet another excellent University.

Applications for the Joint Ph.D. programme should be submitted to either NUS or IITM whichever is the university the candidate wishes to be registered with as their home university. The minimum admission criteria is at least a relevant Bachelor’s degree with Honours (at least 2nd Class Upper) or its equivalent.

Candidates who are interested in pursuing graduate studies in the NUS-IITM Joint Ph.D. programme may visit the website at [http://www.gse.nus.edu.sg/NUS-IITM.html](http://www.gse.nus.edu.sg/NUS-IITM.html)
NUS-IITK Joint Ph.D. Programme
Candidates may also choose to pursue a joint Ph.D. programme with Indian Institute of Technology, Kanpur. With such a linkage to this premier university in India, the NUS-IITK Joint Ph.D. programme will allow candidates to enjoy the best of both universities.

Applications for the Joint Ph.D. programme should be submitted to either NUS or IITK whichever is the university the candidate wishes to be registered with as their home university. The minimum admission criteria is at least a relevant Bachelor’s degree with Honours (at least 2nd Class Upper) or its equivalent.

Candidates who are interested in pursuing graduate studies in the NUS-IITK Joint Ph.D. programme may visit the website at http://www.gse.nus.edu.sg/NUS-IITK.html

NUS-SUTD Joint Ph.D. Programme
The latest joint programme launched, and a first with a local institution, is the NUS-SUTD Joint Ph.D. Programme. Applications for the programme may be made to either NUS or Singapore University of Technology and Design (SUTD), whichever is the university the candidates intend to register with as their home institution. The minimum admission criteria is at least a relevant Bachelor’s degree with Honours (at least 2nd Class Upper) or its equivalent. More details are available at http://www.gse.nus.edu.sg/NUS-SUTD.html

Scholarships
(A) Lee Kong Chian Graduate Scholarships
The Lee Kong Chian Graduate Scholarships are NUS’ most prestigious scholarship awards for graduate students. Up to 5 new awards will be given each year and in keeping with the donor’s desire to see its scholars possess an appropriate balance of intellect and character, scholarship recipients are selected on the basis of demonstrated academic excellence, leadership, exceptional promise as well as commitment to service.

The bond-free Scholarships are open to all nationalities who will be admitted as a candidate for a Ph.D. programme at NUS. Shortlisted candidates will be notified for a scholarship interview either in Singapore or their home country. Award of the Scholarship is based on competition among eligible candidates and performance at the Scholarship interview.

Each award covers:
1. A monthly stipend of S$3,500;
2. Tuition and Miscellaneous Student Fees at NUS;
3. An annual book allowance of S$500;
4. A one-off air travel allowance of S$3,000 (for students admitted from Semester 2, AY2015/2016); and
5. A one-off laptop allowance of S$1,500.

If you wish to apply for the Lee Kong Chian Graduate Scholarship, please also submit the following documents:
(a) A personal statement to describe, in less than 300 words, an exceptional achievement that highlights your academic interests and intellectual capacity that would be of value to the NUS community.
(b) A report (with documentary evidence) on your extra-curricular activities (e.g. committee served, community service, sports etc), and a statement (less than 300 words) about how you have benefited from such participation, and hope to return something to society.

Note: Central Provident Fund (CPF) contributions shall be provided to Singapore Citizens at a rate pegged to the prevailing employer’s contribution rate set by CPF, on top of the monthly stipend received.

(B) President’s Graduate Fellowship (PGF)
The PGF is awarded to candidates who show exceptional promise or accomplishment in research. A number of Ph.D. research students are selected each semester by University for the award.

1. Monthly stipend of S$3,000 to S$3,500 (actual sum depends on the nationality of candidate)
2. Tuition fees at the University;
3. A one-off air travel allowance for 1 one-way ticket of up to S$750 on economy class and up to 20 kg baggage per trip (only for newly registered overseas students’ trip from home country to Singapore to commence study);
4. A one-off settling allowance of S$1,000 (only for overseas students)

The award is tenable for up to a maximum of 4 years, subject to an annual review of the scholar’s satisfactory progress. Short-listed candidates will be invited to an interview either in Singapore or their home country.

Note: With effect from 1 August 2015, Central Provident Fund (CPF) contributions shall be provided at a rate pegged to the prevailing employer's contribution rate set by CPF, on top of the monthly stipend received. All airfare claims must be made within 1 month from date of travel. Please attach original receipt(s) with the relevant completed form and submit it to Registrar's Office.

(C) NUS Research Scholarships
The NUS Research Scholarship is available on a competitive basis to full-time research students who meet the requisite criteria.

<table>
<thead>
<tr>
<th>Monthly stipend for Ph.D. Research Scholars</th>
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<tr>
<td>Pre-QE*</td>
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<tr>
<td>---------</td>
</tr>
<tr>
<td>Singapore Citizens</td>
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<tr>
<td>Singapore Permanent Residents</td>
</tr>
<tr>
<td>International Students</td>
</tr>
</tbody>
</table>

*QE-Stipends are increased upon passing the Ph.D. qualifying examination

The main focus of the Faculty is the Ph.D. programme. Priority for the competitive NUS Research Scholarship will be given to applicants for the full-time Ph.D. programme, while only a limited number may be awarded to applicants for the M.Eng. programme. The NUS Research Scholarship for M.Eng will carry monthly emoluments of S$2,500 (Singapore Citizens) / S$1,500 (SPR/International students), plus full tuition fee subsidy.

Important Note on Scholarships:
International Students who are admitted from AY2014/2015 with NUS Research Scholarship/President's Graduate Fellowship are required to fulfil the requirements of the Graduate Assistantship Programme as set out in the Terms and Conditions for the Scholarship/Fellowship. The Terms and Conditions are available at http://nus.edu.sg/admissions/graduate-studies/scholarships.php

(D) Singapore International Graduate Award (SINGA)
Candidates may apply for the Singapore International Graduate Award (SINGA). Please apply separately online at https://www.singa.a-star.edu.sg. There is no need to submit a simultaneous application on the NUS portal; SINGA will transfer your application to NUS after their review.

(E) Other sponsorships
A limited number of sponsorships from private organisations (having tie-ups with NUS) are also available for suitable candidates. If selected, applicants will receive further information from the sponsoring companies.

For more details and a list of scholarship available, please visit the following website http://www.gse.nus.edu.sg/financial_assistance.html

Period of Candidature
The maximum period of candidature for M.Eng and Ph.D. is three years and five years respectively. The period of candidature is the same for full-time and part-time programmes.

A candidate who is not residing in Singapore has to fulfil a residency requirement during the period of candidature. The residency requirement for M.Eng and Ph.D. candidates is six and eighteen months respectively.
Coursework Requirements – Graduate Modules

Candidates are required to conduct research in their area of interest and submit a thesis before the maximum period of candidature for examination. Besides the thesis requirement, candidates must also attend a prescribed number of courses which the supervisor thinks will be useful for the candidate.

It is a requirement that Ph.D. and M.Eng. students should take at least six and four modules respectively (or its equivalent of 24 and 16 modular credits respectively) excluding certain non-technical modules as mentioned below, unless exemption has been granted by the University. For further details, please check with the Departments/Divisions upon admission.

For fulfilment of the coursework component of the research degrees:

1. **Modular Credits**
   - Each graduate module of 39 lecture hours is to be assigned 4 modular credits (MC).

2. **Grades and Grade Points**
   - Letter grades are mapped to grade points according to the following table:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>5.00</td>
</tr>
<tr>
<td>A</td>
<td>5.00</td>
</tr>
<tr>
<td>A-</td>
<td>4.50</td>
</tr>
<tr>
<td>B+</td>
<td>4.00</td>
</tr>
<tr>
<td>B</td>
<td>3.50</td>
</tr>
<tr>
<td>B-</td>
<td>3.00</td>
</tr>
<tr>
<td>C+</td>
<td>2.50</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>D+</td>
<td>1.50</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
</tr>
<tr>
<td>F (Fail)</td>
<td>0</td>
</tr>
</tbody>
</table>

   - **Cumulative Average Point (CAP) for Graduation**
     - M.Eng. – 3.00
     - Ph.D. – 3.50

3. **Academic Warning, Termination and Graduation**

   (a) For continuation of candidature:
   - (i) In the 1st semester of study, the CAP should not fall below 1.50; or
   - (ii) for M.Eng.: CAP should not fall below 2.50 for 2 consecutive semesters; or
   - CAP should not fall below 3.00 for 3 consecutive semesters
   - for Ph.D.: CAP should not fall below 3.00 for 2 consecutive semesters; or
   - CAP should not fall below 3.50 for 3 consecutive semesters

   Students whose CAP does not meet the requirements as stated above will be recommended for termination of candidature.

   For any semester in which the student's CAP falls below the CAP required for graduation (i.e. 3.00 for M.Eng. and 3.50 for Ph.D.), he/she will be issued an academic warning. A student may also be issued an academic warning or placed on probation for poor performance in the Qualifying Examination, research, or other programme requirements.

   (b) For graduation,
   - (i) **MEng** students (in all Departments except Electrical & Computer Engineering) must:
     - obtain at least 16 MCs (Graduate Seminars and Graduate English Course modules are not included), of which at least 12 MCs must be at graduate level within the subject or in related disciplines and the remaining credits may be from other levels in the same or other disciplines subject to the approval of the Department; &
     - obtain CAP ≥ 3.00 in the best 4 modules (or equivalent of 16 MCs); &
     - pass the MEng thesis; &
     - obtain minimum Grade C in the Graduate English Course (Intermediate Level), where applicable; &
     - Satisfactory Grade for Graduate Seminars.
     - Satisfactory Grade for EG5911: Research Methodology & Ethics module
(ii) MEng students (in Department of Electrical & Computer Engineering) must:

- obtain at least 16 MCs (Graduate Seminars and Graduate English Course modules are not included), of which 16 MCs must be at graduate level within the subject or in related disciplines, subjected to approval of the Department. The modules comprise of 2 core (level 5000) and 2 research (level 6000) modules; &
- obtain CAP ≥ 3.00 in the best 4 modules (or equivalent of 16 MCs); &
- obtain minimum Grade C in ES5101 Technical Communication for Engineers (O MC, graded).
- pass the M.Eng. thesis; &
- obtain minimum Grade C in the Graduate English Course (Intermediate Level), where applicable; &
- Satisfactory Grade for Graduate Seminars.
- Satisfactory Grade for EG5911: Research Methodology & Ethics module

(iii) PhD students (in all Departments except Electrical & Computer and Industrial & Systems Eng) must:

- obtain at least 24 MCs (Doctoral Seminars and Graduate English Course modules are not included), of which at least 18 MCs must be at graduate level within the subject or in related disciplines and the remaining credits may be from other levels in the same or other disciplines subject to the approval of the Department; &
- obtain CAP ≥ 3.50 in the best 6 modules (or equivalent of 24 MCs); &
- pass the Qualifying Examination; &
- pass the PhD thesis and Oral Examination; &
- obtain minimum Grade C in the Graduate English Course (Intermediate Level), where applicable; &
- Satisfactory Grade for EG5911: Research Methodology & Ethics module: &
- Satisfactory Grade for Doctoral Seminars.

(iv) PhD students (in Department of Electrical & Computer Eng) must:

- obtain at least 24 MCs (Doctoral Seminars and Graduate English Course modules are not included), of which 24 MCs must be at graduate level within the subject or in related disciplines, subjected to approval of the Department. The modules comprise of 3 core (level 5000) and 3 research (level 6000) modules; &
- obtain Satisfactory Grade for EE6990 Research Attachment of 4 MCs (2x2); &
- obtain CAP ≥ 3.50 in the best 6 modules (or equivalent of 24 MCs); &
- obtain minimum Grade C in ES5101 Technical Communication for Engineers (O MC, graded).
- pass the Qualifying Examination; &
- pass the PhD thesis and Oral Examination; &
- obtain minimum Grade C in the Graduate English Course (Intermediate and Advanced Levels), where applicable; &
- Satisfactory Grade for EG5911: Research Methodology & Ethics module: &
- Satisfactory Grade for Doctoral Seminars.

(v) PhD students (in Department of Industrial & Systems Eng) must:

- obtain at least 32 MCs (Doctoral Seminars and Graduate English Course modules are not included), of which at least 24 MCs must be at graduate level within the subject or in related disciplines and the remaining credits may be from other levels in the same or other disciplines subject to the approval of the Department; &
- obtain CAP ≥ 3.50 in the best 8 modules (or equivalent of 32 MCs); &
- pass the Qualifying Examination; &
- pass the PhD thesis and Oral Examination; &
- obtain minimum Grade C in the Graduate English Course (Intermediate and Advanced Levels), where applicable; &
- Satisfactory Grade for EG5911: Research Methodology & Ethics module: &
- Satisfactory Grade for Doctoral Seminars.

Notes:
CAP = Cumulative Average Point
Formulae for CAP = \[
\frac{\text{Sum (Grade Pt x MC)}}{\text{Sum (MC)}}
\]
All letter grades (including Grade F) are computed in the CAP computation for students who have yet to accumulate the minimum number of modular credits for graduation. For students who have accumulated more than the minimum number of modular credits for graduation, the CAP is computed using the best modules equivalent to minimum number of modular credits (inclusive of foundation/core modules, where required).

CELC modules (i.e. Graduate English Courses) are excluded from the computation of the average grade for fulfilment of coursework requirement.

All classes are normally conducted in the evenings from 6:00 pm to 9:00 pm from Mondays to Fridays. Candidates should discuss with and obtain approval from their supervisor(s) on the courses that they should attend.

Language of Instruction
The graduate courses are conducted in English.

English Language Requirements
All international students are required to take a Diagnostic English Test (unless exemption has been granted. Any exemption from this requirement would be indicated in the letter of offer for admission to the M.Eng./Ph.D. programme).

Fees
The fees for AY2015/2016 as follows:

**Tuition Fees (per Annum)**

<table>
<thead>
<tr>
<th>Category of Graduate Programme</th>
<th>Singapore Citizens</th>
<th>Singapore Permanent Residents</th>
<th>International Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Programmes offered by Engineering</td>
<td>7,600</td>
<td>10,650</td>
<td>26,700</td>
</tr>
</tbody>
</table>

**Notes:**
1. All fee amounts quoted here are subsidised by the Singapore government (through the Ministry of Education, MOE) and are exclusive of prevailing GST. The applicable GST is subsidised by the MOE.

2. Students in MOE-subsidised coursework programmes who are Singapore Citizens and aged 40 and above (based on the year which the student turns 40 years old) may be eligible for higher subsidy under the SkillsFuture Mid-Career Enhanced Subsidy. The fees payable will be 60% lower than the standard subsidised fees payable by other Singaporean students. The amount of fees payable will be reflected in their individual student bill.

3. Students who are not eligible for MOE subsidy are also not eligible for the enhanced subsidy.

4. Students who have previously enjoyed government subsidy or sponsorship by a Singapore government agency (such as scholarships offered by the Ministries, Public Service Commission and Statutory Boards) in a graduate programme should refer to the Eligibility Guidelines for MOE Subsidy.

Students who are not eligible for MOE subsidy are also ineligible for some scholarships. For more details, please refer to Scholarships/Awards. All students affected as above are to refer to their individual student bills for the amount of fees payable.
### Miscellaneous Student Fees

<table>
<thead>
<tr>
<th></th>
<th>Full time Students</th>
<th>Part time students</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Services Fees (Lab-based)</td>
<td>S$155.55</td>
<td>S$122.20</td>
<td>Payable per semester</td>
</tr>
<tr>
<td>Health Service Fee</td>
<td>S$62.85</td>
<td>-</td>
<td>For local and international students, payable per semester</td>
</tr>
<tr>
<td>Late Payment Charge</td>
<td>S$25</td>
<td>S$25</td>
<td>Please refer to OFS for details.</td>
</tr>
</tbody>
</table>

**Notes:**
3. (a) Miscellaneous Student fees are payable per semester.
   (b) If fees are not paid by the due date indicated in the bill each semester, a late fee may be imposed.
   (c) All fees shown here include prevailing GST, unless otherwise indicated.

### Staff Concession on NUS Government-Subsidized Graduate Programmes

Full time staff members who wish to upgrade themselves with higher qualifications through programmes offered by NUS can apply to enjoy the concessionary rates on tuition fees for government subsidized graduate programmes. The concession works on the basis of an equitable dollar quantum concession based on the dollar quantum concession applicable to Singapore Citizen.

<table>
<thead>
<tr>
<th>Concession / Discount</th>
<th>Singapore Citizens</th>
<th>SPR &amp; International Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government-subsidized Research Programme</td>
<td>Full waiver</td>
<td>Published fees payable by Singapore Citizens</td>
</tr>
</tbody>
</table>

Other guidelines for this staff concession are:
a. The concession covers only the tuition fees.
b. No service bond with NUS will be imposed.
c. For more details, staff may refer to the Office of Human Resources website or the write-up at https://share.nus.edu.sg/corporate/policies/hr2/benefits/government-subsidized-graduate-programs.pdf

### Deferment

Should you require a deferment to register as a higher degree candidate, you will be advised to reapply for the next intake.
University Term
The University's academic year for 2016/2017 is as follows:

**Academic Calendar 2016/2017**

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Date</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 1 Aug - Sat 3 Dec 2016</td>
<td>18 weeks</td>
<td></td>
</tr>
<tr>
<td>Orientation Week:</td>
<td>Mon 1 Aug - Sat 6 Aug 2016</td>
<td>1 week</td>
</tr>
<tr>
<td>Week 1 to 6:</td>
<td>Mon 8 Aug – Fri 16 Sep 2016</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Recess Week:</td>
<td>Sat 17 Sep – Sun 25 Sep 2016</td>
<td>1 week</td>
</tr>
<tr>
<td>Week 7 to 13:</td>
<td>Mon 26 Sep – Fri 11 Nov 2016</td>
<td>7 weeks</td>
</tr>
<tr>
<td>Reading Week:</td>
<td>Sat 12 Nov - Fri 18 Nov 2016</td>
<td>1 week</td>
</tr>
<tr>
<td>Examination:</td>
<td>Sat 19 Nov - Sat 3 Dec 2016</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Vacation:</td>
<td>Sun 4 Dec 2016 - Sun 8 Jan 2017</td>
<td>5 weeks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 2</th>
<th>Date</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 9 Jan – Sat 6 May 2017</td>
<td>17 weeks</td>
<td></td>
</tr>
<tr>
<td>Week 1 to 6:</td>
<td>Mon 9 Jan – Fri 17 Feb 2017</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Recess Week:</td>
<td>Sat 18 Feb – Sun 26 Feb 2017</td>
<td>1 week</td>
</tr>
<tr>
<td>Week 7 to 13:</td>
<td>Mon 27 Feb – Fri 14 Apr 2017</td>
<td>7 weeks</td>
</tr>
<tr>
<td>Reading Week:</td>
<td>Sat 15 Apr - Fri 21 Apr 2017</td>
<td>1 week</td>
</tr>
<tr>
<td>Examination:</td>
<td>Sat 22 Apr - Sat 6 May 2017</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Vacation:</td>
<td>Sun 7 May - Sun 30 Jul 2017</td>
<td>12 weeks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special Term</th>
<th>Date</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 8 May - Sat 17 Jun 2017</td>
<td>6 weeks</td>
<td></td>
</tr>
<tr>
<td>Mon 19 Jun – Sat 29 Jul 2017</td>
<td>6 weeks</td>
<td></td>
</tr>
</tbody>
</table>
Department of Biomedical Engineering

About the Department

The Department of Biomedical Engineering was formally launched as a University Department in July 2002, with strong participation from the Faculties of Engineering, Medicine, Sciences and Dentistry, along with the local Research Institutes. Our vision is to be a leading Biomedical Engineering Department, advancing knowledge and nurturing talent.

The Department has close to 40 academic staff, the majority of whom have joint appointments with various departments such as Mechanical Engineering, Chemical & Biomolecular Engineering, Electrical & Computer Engineering, Orthopaedic Surgery, Surgery, Biochemistry, Biological Sciences and research institutes such as IMRE and CIRC. It is supported by almost 50 research staff and a dozen technical and administrative staff.

About the Graduate Programme

Biomedical Engineering is a discipline in which the principles and tools of traditional engineering disciplines are applied to the analysis and solution of problems in biology and medicine. A biomedical engineering education aims to train engineers who can analyse and overcome complex problems from engineering, biological and medical perspectives. The graduate biomedical engineering curriculum is designed to teach concepts and approaches, adapted from both engineering and the life sciences, in an integrative manner to achieve these objectives. Our integrated approach provides a good balance between the requirements of a broad biomedical engineering perspective and the chosen research specialisation.

Areas of Research

Research within the Department of Biomedical Engineering has been broadly classified into the following four major research focus areas:

- Biomaterials / Tissue Engineering & Repair
- Biosignal Processing / Bioimaging
- Nanobioengineering
- Biomechanics / Computational Bioengineering
- Biorobotics
- Neuroengineering / Neurotechnology

The Department has high quality staff in each of these areas and details of our research activities can be found in the Laboratories pages on our website. The Department also actively collaborates with research groups at the Faculty of Science, Duke-NUS Medical School, Yong Loo Lin School of Medicine, National University Hospital, NUS Life Sciences Institute as well as the Institute of Materials Research and Engineering, Institute of Molecular and Cell Biology, Institute of Medical Biology and the Institute of High Performance of Computing at A*STAR. In addition, we have active collaborations with overseas institutions such as MIT, Duke University, Institut Pasteur, Tohoku University, Peking University and many others.

Our facilities

To facilitate research in biomedical engineering, the Department has set up a Bioengineering & Nanobioengineering Corridor and a new Biomedical Engineering Cluster using a multi-disciplinary joint-laboratory concept to bring the various biomedical engineering research groups under one roof. The aim is to develop core competencies in biomedical engineering and to facilitate the exchange of ideas among the various research groups, not only within but also outside of the University and in the process, foster multi-disciplinary teaching, learning and research.

Housed within the Bioengineering & Nanobioengineering Corridor are the Biofluid Mechanics Research Lab, Biosignal Processing & Instrumentation Lab, Computational Bioengineering Lab, Computational Functional Anatomy Lab, Microhemodynamics Lab, Nanobiomechanics Lab, Nanobioengineering Lab, Regenerative Nanomedicine Lab and the Tissue Repair Lab.
The new Biomedical Engineering Cluster comprises the Biofluids Lab, Biomedical Mechanics & Materials Lab, Cardiovascular Biomechanics and Ultrasound Lab, Cellular & Molecular Bioengineering Lab, Medical Mechatronics Lab, Nano Bioanalytics Lab, Optical Bioimaging Lab, and the Supramolecular Biomaterials Lab.

Elsewhere we also have the Integrated Microfluidic Biotechnology Lab, In-Vivo Biomechanics Lab, Nanomedicine & Nanobiology Lab, Tissue Modulation Lab, and the Biomedical Robotics Lab.

A number of sophisticated state of the art instruments and facilities are housed in these labs giving the Department an edge in performing frontline research. The lab concept includes shared facilities such as a BSL2 lab and imaging hardware with easy access for researchers, thus adding to the collaborative research environment at the Department of Biomedical Engineering. The wide range of facilities and specialised staff allows students to be exposed to and pursue their chosen area of research.

**How to apply**

Students who are interested to pursue graduate studies may enrol through the Faculty of Engineering for a research-based program (http://www.gse.nus.edu.sg/applications.html). Applicants are encouraged to apply on-line. Priority for scholarships is given to Ph.D applicants.

Please visit our website (http://www.bioeng.nus.edu.sg/) for more information and our contact details.

**Faculty Members**

- ALL Angelo, University of Verona, Italy
- BUIST Martin, University of Auckland, New Zealand
- CHAN Casey, University of Toronto, Canada
- CHEN Chia-Hung, University of Cambridge, UK
- CHEN Nanguang, Tsinghua University, China
- CHONG Yok Rue, Desmond, Imperial College London, UK
- CHOO Andre Boon Hwa
- CORRIAS Alberto, National University of Singapore, Singapore
- GARAJ Slaven, EPFL, Switzerland
- GIRAD Michael, Tulane University, USA
- MUSIB Mrinal Kanti, University of Texas, San Antonio, USA
- GOH Cho Hong, James, University of Strathclyde, UK
- HUANG Zhiwei, Nanyang Technological University, Singapore
- KAH Chen Yong, James, National University of Singapore, Singapore
- KANCHANAWONG Pakorn, Tony, Stanford University, USA
- KIM Sangho, Drexel University, USA
- LEO Hwa Liang, Georgia Institute of Technology, USA
- LI Jun, Osaka University, Japan
- LIM Chwee Teck, University of Cambridge, UK
- QIU Anqi, John Hopkins University, USA
- RAGHUNATH Michael, Mainz University, Germany
- REN Hongliang, Chinese University of Hong Kong, Hong Kong
- ZAIDEL BAR Ronen
- SUBRAMANIAM Tamil Selvan, Madurai Kamaraj University, India
- THAKOR Nitish Vyomesh, University of Wisconsin, Madison, USA
- TOH Siew Lok, University of Strathclyde, UK
- TOH Yi-Chin, National University of Singapore, Singapore
- TRAU Dieter Wilhelm, Hong Kong University of Science & Technology
- YIM Evelyn King Fai, John Hopkins University, USA
- YEOH Chen Hua, National University of Singapore, Singapore
- YAP Choon Hwai, Georgia Institute of Technology
- YU Haoyong, MIT, USA
- ZHANG Yong, Zhejiang University, China
ABOUT OUR DEPARTMENT

The Department of Chemical & Biomolecular Engineering at the National University of Singapore is the leading chemical engineering department in Asia and is ranked 5th in the world (QS World University rankings by subject – 2014). We are also one of the largest in the world, with more than 40 faculty members, about 140 research and support staff, more than 240 graduate students and over 1200 undergraduate students. Our Department possesses a comprehensive research infrastructure with top-notch facilities for carrying out cutting-edge research. We strive to provide graduate students with an environment that is conducive for initiative and creativity. With research activities that are comparable to those in the best universities in the world and with partnerships with leading universities around the globe, our Department enjoys a pre- eminent status in the discipline. In fact, the mission of our Department calls for further enhancement of our standing internationally.

OUR SCOPE: From Classical to Contemporary

Intellectually, our Department provides the critical link between engineering and the sciences, particularly the chemical and life sciences, by bridging the gap between molecular-level, laboratory-scale studies of chemical and biological transformations and the large-scale industrial production operations. With the recent revolution in molecular biology and life sciences, our Department has expanded our traditional scope to include solutions to problems in biomedicine, biotechnology, systems biology, protein engineering, drug-delivery systems, and chemotherapeutic engineering, among others.

Our Department has also responded to the emergence of nanoscience and technology as a viable new frontier by expanding the classical role of chemical engineering in “scaling up” processes to include problems that require “scaling down” phenomena and processes for applications in labs-on-chips and plants-on-chips devices. While consolidating and extending our scope in biological and life sciences, our Department continues to maintain and enhance our strengths in traditional core areas such as process and systems engineering, catalysis and reaction engineering, advanced separation processes and transport phenomena. At the same time, we support innovative activities in functionalized and smart materials (e.g., for biosensors, molecular and polymer electronics, novel smart membranes for separation processes and novel optoelectronic and photonic materials) and nanostructured materials (e.g., for new catalysts and fuel cells).

WHY ChBE @ NUS?

- Excellent academic reputation
- Joint programmes with leading universities such as Imperial College London, UK
- Cutting-edge research straddling multidisciplinary fields
- Synergistic combination of science and technology
- Top-notch infrastructure – excellent analytical and computational facilities
- Dedicated faculty with excellent credentials
- Vibrant and stimulating intellectual and cultural atmosphere
- Excellent career prospects

MAJOR RESEARCH AREAS

The Department’s activities may be classified under the following major themes:

1. Chemical Engineering Sciences
2. Chemical & Biological Systems Engineering
3. Environmentally Benign Processing and Sustainability
4. Biomolecular and Biomedical Sciences
5. Nanostructured and Functionalized Materials & Devices
1. Chemical Engineering Sciences

Chemical engineering as a distinct discipline has evolved from industrial chemistry and empiricism into a field that combines the understanding and predictive capabilities of fundamental physical sciences with the final goal of design and control of industrial scale applications. Research in Chemical Engineering Sciences in the Department covers the classical topics, such as thermodynamics, reaction engineering and catalysis, transport phenomena, separation processes and colloidal and interfacial phenomena, often with a modern twist. Many of the activities in Chemical Engineering Sciences also provide the foundation for other thrusts. The Department interacts closely, through research activities and faculty joint appointments, with the Institute of Chemical and Engineering Sciences (a national Research Institute) funded by the Agency for Science, Technology and Research (A*STAR) of Singapore.

Examples of activities in this thrust include
- Thermodynamics of submicroscopic systems and macromolecular solutions (e.g., folding and conformation of polymeric and protein structures)
- Heterogeneous and homogeneous catalysis and ab initio mechanistic studies; photocatalysis for environmental pollution control; asymmetric reactions for fine chemicals & pharmaceuticals; Chemometrics
- Computational fluids dynamics; crystallization kinetics; dynamics of complex fluids
- Asymmetric and composite membranes for gas separation; liquid membranes for metal extraction and bioproduct recovery; Novel biomimetic membranes; Adsorptive separations.
- Self-assembly and surfactant solutions; electrokinetics; electrophoretic separation of proteins

2. Chemical & Biological Systems Engineering

The Department has one of the largest research groups in the world in Process Systems Engineering (PSE), an area central to chemical, biochemical and other process industries. With the emerging focus on biomolecular engineering, our PSE group has reshaped itself as the Chemical & Biological Systems Thrust (ChemBioSys) to provide the much-needed systems perspective in biology and biotechnology. The main objective of the thrust is the development of efficient methodologies and tools to obtain innovative and non-intuitive solutions for the design and operation of chemical and biomolecular systems. Recent developments in life sciences have opened up formidable challenges and unique opportunities in areas such as systems biology and bioinformatics, which require systems approach. Therefore, chemical sciences coupled with sophisticated computational techniques – ranging from statistical data analysis and optimization to artificial intelligence – provide an excellent platform for deriving deep insight into biological systems.

Some of the ongoing activities include
- Process modeling, simulation & parameter estimation; Process optimization
- Process dynamics & control of macroscopic systems as well as microsystems
- Process design & development; Process operations & safety
- Artificial intelligence (AI) applications
- Genetic data mining for systems biology

3. Environmentally Benign Processing and Sustainability

Environmentally benign processing and sustainability is a major research thrust in the Department. This programme deals with both "upstream" design and "downstream" treatment and involves chemical syntheses, chemical engineering, biomolecular engineering, and cross-disciplinary interactions. Several faculty members have research projects in the following areas related to energy, carbon dioxide capture and utilization, and sustainable materials and processes:

- Natural gas processing
- Advanced membranes for water production and recycle
- Smart energy systems, electrochemical energy storage and conversion
- Energy efficiency, engineering reactions and processes on the molecular scale
- Bio-based chemicals and fuels
- Desulfurization including bio-desulfurization
- Biodegradation, process integration, water/fuel/CO\textsubscript{2} networks
- Life cycle assessment and sustainability studies
- Bio-extractive waste treatment
4. Biomolecular and Biomedical Sciences

The transformation of biology from a descriptive to a molecular science and the current, unprecedented ability to manipulate biological cells at the genetic level have revolutionized the interaction between chemical engineering and biology and life sciences. The research and educational programmes in the Department in Biomolecular and Biomedical Engineering recognize that biology at the molecular level is a chemical science and that biological cells are cellular factories. The Department has a long-standing record of research and education in areas that cut across disciplinary boundaries in biological and life sciences and has played a major role in shaping the direction of research in the nation. An example is A*STAR’s Bioprocessing Technology Institute, which evolved out of the Bioprocessing Technology Centre within the Department, and the Joint BTI-ChBE Research and Educational Laboratory.

Current research activities include
- Development of drug delivery systems
- Biomolecular functionalization for biosensors
- Molecular level control of biomolecules for fabricating biomolecular micro/nanodevices
- Modification of proteins to target them for desired materials; Protein biosynthesis from genetically modified microbes
- Genetic data mining for systems biology
- Tissue engineering with synthetic and natural polymers; Biomaterials for biomedical applications
- Biocatalysis for selective and environmentally benign transformations

5. Nanostructured and Functionalized Materials & Devices

Another major area of research in the Department focuses on specially functionalized materials for biosensors, polymer electronics, novel tunable membranes and for applications in life sciences. This thrust also encompasses activities in synthesis of nanostructured materials for catalysis, separations technology fuel cells, electronics and optics. The research programmes span a wide range of length scales, from molecular-level synthesis and manipulation of materials to the macroscopic fabrication of surfaces and bulk materials and nanocomposites. Excellent in-house analytical and characterization facilities provide support for cutting-edge research endeavours in
- Molecular, nano- and surface/interfacial engineering; Functionalized surfaces for biotechnology; Surface-wired biomolecules
- Functional materials for separations, energy conversion, optics, electronics and sensing
- Biomaterials, catalysts and membranes; Polymeric scaffolds for tissue engineering
- Nano-structured, hybrid and composite materials for biological and biomedical applications
- Processing methodologies, self-assembling processes, nano- and molecular patterning

WHOM TO CONTACT

For further information on the application procedure or departmental research activities, please contact –

Postgraduate Committee
Department of Chemical & Biomolecular Engineering
Blk E5 #02-09
4 Engineering Drive 4
National University of Singapore
Singapore 117585
Phone: (65) 6516 5031
Fax: (65) 6779 1936
E-mail: chbe_grad_programs@nus.edu.sg

You can find out more about the Department at our Homepage:
www.chbe.nus.edu.sg

Details about application for graduate studies and financial assistance are available at
http://www.gse.nus.edu.sg/postgradprog.html
The Department of Civil & Environmental Engineering is actively involved in the education and training of its students, in research and development work as well as in providing consultancy and advisory services. The Department contributes to the transfer of technology to industry and the public through conferences, workshops, seminars, short courses, and consultancy services. Staff achievements include patents granted for discoveries and inventions, successful commercialisation and licensing of technological innovations, and launching of spin-off companies. In the latest QS ranking 2014, Civil Engineering is ranked 7th and Environmental Engineering 14th among the best universities in the world.

Approximately S$66 million in research funding was received during the period 2010 to 2014. The Department participates in synergistic collaborations with local and overseas partners involving academia, industry, government bodies and international agencies to seek expertise from around the world and to enhance existing capabilities. This interaction allows faculty members to undertake translational engineering so as to facilitate the effective transfer of research findings to the industry. Staffs also engage in multidisciplinary collaborative research with national research institutes and centres, including the Keppel-NUS Corporate Laboratory, the Tropical Marine Science Institute (TMSI) and the Institute for High Performance Computing (IHPC).

There are 2 programmes in the Department, namely the Civil Engineering Programme and the Environmental Engineering programme.

(1) Civil Engineering Programme

The Civil Engineering Programme deals with various research issues related to infrastructures both onshore and offshore. The major topics of research carried out in the programme are:

**Offshore Engineering**
Innovative Structural Systems; Jack-Up Platform and Floating Production Systems; Marine Operations and Installation; Very Large Floating Structures; Offshore Geotechnics; Deep Water

**Protective Engineering**
Advanced and New Protective Materials; Airblast and Groundshock Effects, including Blast-Induced Liquefaction; Hardening and Protective Measures for Structures, Personnels and Vehicles; Rapidly Deployable Protective Structures

**Hazards, Risks and Mitigation**
Design and Protection of Infrastructures against Natural and Manmade Hazards; Disaster Prevention and Mitigation; Earthquake Effects on Soils, Foundations and Structures; Earthquake Tectonics; Hazards Induced by Climate Change; Risk Analysis and Management; Tsunami Forecasting, Propagation and Run-Up

**Structural Engineering**
High Strength, Lightweight and High-Performance Materials; Novel Composite Structural Systems; Repair and Strengthening; Smart Materials and Structural Health Monitoring

**Geotechnical Engineering**
Land reclamation, Ground Improvement, Coastal/Marine Geotechnics; Underground Construction

**Hydrology and Hydraulic Engineering**
Coastal Engineering & Protection; Modelling of Hydrodynamic and Transport Process; Environmental Hydraulics; Hydroinformatics; Water Resources Planning and Management

**Infrastructure Systems**
Intelligent Transportation Systems; Transportation Logistics; Infrastructure & Project Management; Performance-based Asset Management
(2) Environmental Engineering Programme

Environmental problems are some of the most complex, challenging, and pressing issues that are of concern to engineers, scientists and policy makers. Achieving environmental sustainability is a key priority for Singapore and the world. The Environment of the Globe is the focus of education and research programs which include global climate change, water reclamation, portable-water development, barriers to infectious-disease transmission, human health-effects, water resources, sensors for monitoring contaminants, membranes innovation, alternative energy systems, industrial ecology and more.

The programme emphasizes multi-disciplinary approaches to solving complex environmental problems and is organized into three broad research clusters related to engineering applications in all relevant environmental media – air, water, and soil. It promotes unique research and educational opportunities in the following fields:

Aerosol science & technology; Air pollution assessment & control; Environmental chemistry & biochemistry; Environmental microbiology & biotechnology; Climate change; Energy resources, conservation & alternatives; Hazardous & solid waste; Human & environmental health; Industrial ecology; Marine & coastal systems; Membrane separations & technologies; Nano-biotechnology & nano-materials; Renewal energy; Sensor systems in air, land & water; Separation science & technologies; Sustainable Development; System modelling & simulation; Water quality & treatment; Wastewater reclamation & reuse; Water resources.

Faculty members

Faculty research activities are a reflection of the expertise of its faculty members, who are multinational, highly trained, and well regarded in both academic and industrial sectors. Several faculty members have been honoured with international awards in recognition of contributions made in their respective fields of expertise, including the IASS Hangai Prize 2010 from the International Association for Shell and Spatial Structures, Alfred Noble Prize 2009 from the American Society of Civil Engineers, USA; the Lewis Kent Award 2009 from The Institution of Structural Engineers, United Kingdom; the Lifetime Achievement Award at ShipTek 2009; the Minister's Innovation Award 2009 - Merit Award from the Ministry of Transport, Singapore; and the Design and Engineering Safety Excellence Merit Award 2008 in the Civil Engineering Category from the Building and Construction Authority of Singapore. A notable number of staff has also been invited to deliver keynote lectures and to serve on international advisory boards and technical committees, and as editors or reviewers of reputable international journals.

The list of faculty members in the Department is given below:

Prof Chan Eng Soon, ScD MIT, MEng NUS, BEng Sing
Prof Cheong Hin Fatt, PhD Colorado State, MSc Cin, BEng Sing, PEng
Prof Choo Yoo Sang, PhD MSc BSc Manc, PEng
Prof Chow Yean Khow, PhD MSc BSc Manc, PEng
Prof Fwa Tien Fang, PhD Purdue, MASc Waterloo, BEng Sing, PEng
Prof Koh Chan Ghee, PhD MSc UC Berkeley, MEng NUS, BEng Sing, PEng
Prof Lee Der-Horng, PhD Illinois, MSc Nat Cen, BBA Tamkang
Prof Lee Fook Hou, PhD MPhil Camb, MEng NUS, BEng Monash, PEng
Prof Leung Chun Fai, PhD BEng Liv, PEng
Prof Liew Jat Yan, Richard, PhD Purdue, MEng BE NUS, CEng, Peng
Prof Martin Reinhard PhD Dip ETH- Zürich
Prof Ong Say Leong, PhD Toronto, MESc Western Ontario, BEng Sing, PEng
Prof Palmer, Andrew Clennel, PhD Brown, BSc Cambridge.
Prof Phoon Kok Kwang, PhD Cornell, MEng BEng NUS
Prof Quek Ser Tong*, PhD MS UIUC, MEng NUS, BEng Monash, PEng
Prof Somsak Swaddiwudhipong, PhD Hong Kong, MEng AIT, BEng Chulalongkorn, PEng
Prof Tan Kiang Hwee, Dr Eng Tokyo, MEng NUS, BEng Tokyo IT, PEng
Prof Wang Chien Ming, PhD MEng Sc BE Monash
Prof Yong Kwet Yew, PhD BEng Sheff, PEng
Prof Zhang Min Hong, Dr Ing NTNU Norway, BSc Tongji China
A/Prof Ang Kok Keng, PhD NSW, MEng NUS, BEng Sing, PEng
A/Prof Bai Renbi, PhD Dundee, MEng & Beng Chongqing
A/Prof Balasubramaniam Rajasekhar, PhD Miami, MTech IIT Delhi, MSc IIT Madras, BSc Madurai
A/Prof Babovic, Vladan, Dip HE Delft, MSc IHE-Delft, PhD TU Delft and UNESCO-IHE
A/Prof Chan Weng Tat, PhD MSc Stanford, MEng NUS, BEng Sing
A/Prof Chen J Paul, PhD Georgia, MS Tsinghua, BS Hua Chiao
A/Prof Chin Hoong Chor, PhD S’ton, MEng NUS, BEng Sing
A/Prof Chua Kim Huat, David, PhD MSc UC Berkeley, MEng NUS, BEng Adel, PEng
A/Prof Gin Yew-Hoong, Karina, PhDScD Massachusetts & Woods Hole Oceanographic Institution, MEng NUS, BEng Melbourne
A/Prof He Jianzhong, PhD Georgia, MS Tsinghua, BS Harbin
A/Prof Hu Jiangyong, PhD, MEng & BEng Tsinghua
A/Prof Meng Qiang, PhD Hong Kong UST, MSc Chinese Acad of Sc, BSc East China
A/Prof Ng How Yong, PhD California, MEng & BEng NUS
A/Prof Ong Khim Chye, Gary, PhD Diploma Dund, BEng Sing, PEng
A/Prof Pang Sze Dai, PhD Northwestern, MEng NUS, BEng NUS
A/Prof Qian Xudong, PhD & BEng NUS
A/Prof Tan Siew Ann, PhD MSc UC Berkeley, MEng NUS, BEng Auck, PEng
A/Prof Yu Liya, PhD & MSc Stanford, BEng National Cheng Kung
Dr Bai Wei, PhD BEng Dalian UT
Dr Chew Soon Hoe, PhD MSc UC Berkeley, MEng BEng NUS
Dr Chian Siau Chen, PhD Cambridge, BEng NTU
Dr Chua Pei Wen, Vivien, PhD & MS Stanford, BS Georgia Tech
Dr Goh Siang Huat, PhD Cornell, MEng BEng NUS
Dr Jason Blake Cohen, ScD MIT, MSc Caltech, A.B. UC Berkeley.
Dr Kelly, Barry, PhD & MRM Simon Fraser, BSc Trent
Dr Ku, Taeseo, PhD Georgia Tech, MSc UC Berkeley, BSc Yonsei
Dr Kuang Sze Chiang, Kevin, PhD Liverpool, MBA Leicester, BEng Leeds, UK
Dr Lefebvre Olivier Patrick, PhD & MSc Montpellier SupAgro, FRANCE
Dr Low Ying Ming, PhD Cambridge, MEng Imperial College, London
Dr Ong Ghim Ping, Raymond, PhD BEng NUS
Dr Poh Leong Hien, PhD NUS-TUDelft, MEng & BEng, NUS
Dr Yeh Jen-Feng, Pat, PhD MIT, MSc National Chiao-Tung, Taiwan, BSc NTU, Taiwan
Dr Yeoh Ker-Wei PhD BEng NUS
Dr Yuan Jing, PhD MIT, BEng Tsinghua

*Acting Head of Department

For more information, please contact:

Department of Civil & Environmental Engineering
National University of Singapore
Block E1A #07-03, 1 Engineering Drive 2
Singapore 117576
Tel : (65) 6516 2165
Fax : (65) 6779 1635
E-mail : ceebox5@nus.edu.sg
Website: http://www.eng.nus.edu.sg/cee/
Introduction

Electrical Engineering and Computer Engineering are among the most exciting and challenging areas of engineering, and are key disciplines in a highly technological society. Electrical and computer engineers have been driving the evolution of technology through effective application of fundamental concepts and integration of knowledge from various disciplines. Pursuing frontier research, creating new ideas and innovations, and designing and developing new products lie at the heart of ECE.

About our department

The Electrical & Computer Engineering (ECE) Department is the largest department in the Faculty of Engineering, comprising a team of some 100 faculty members recruited from all over the world. They are well respected in their areas of research and education, and engage in research activities encompassing a wide range of topics in communications & networks, control, intelligent systems & robotics, integrated circuits & embedded systems, microelectronic technologies & devices, microwave & RF, power & energy systems, and signal processing & new media.

Doctor of Philosophy (Ph.D.) and Master of Engineering (M.Eng.) Programs

The Doctor of Philosophy (Ph.D.) and Master of Engineering (M.Eng.) programs are research based (curricula and application details can be obtained from http://www.ece.nus.edu.sg/education/graduate/PhD.html). The programs aim to train technologists, leaders and technopreneurs in R&D with a strong foundation in science and technology, who are able to contribute to society at large and to the rapidly evolving knowledge-based Singapore economy through innovation, enterprise, and leadership. The Department also offers Joint Ph.D programmes with a number of renowned universities around the world. Currently, we have over 340 Ph.D. students and about 30 M.Eng. students, who carry out their research work in a dynamic research environment.

Research

We have over 30 research centres/laboratories within the Department and many of them are equipped with state-of-the-art facilities. Our research activities have led to our faculty members garnering significant international awards and recognition.

The department has internationally renowned faculty. Among the honours and prizes awarded to faculty in years 2014–2015, one professor was elevated to IEEE Fellowship, while another was honoured as an International Fellow of the Royal Academy of Engineering, UK. A professor was conferred as Fellow of the International Association for Pattern Recognition, while another was appointed as the IEEE Vice President (Member & Geographic Activities). A professor was listed as one of Thomson Reuters’ prestigious ISI Highly Cited Researchers in 2014. In addition, best paper awards were won by other faculty members at international conferences and high-profile competitions.

In addition, our Ph.D./M.Eng. students have won both international and local awards in year 2014 -- 2015. These awards include Microsoft Research Asia Fellowship; Society of Instrument and Control Engineers (SICE) International Scholarship; Best Presentation (Building Energy Management Technologies Session, IECON); Best Student Paper (ISGT-Asia); and oral paper & poster awards (ISMM).

Presently, we have 138 on-going funded research projects with a total funding of around S$117 million. ECE actively collaborates not only with national research institutes, industry partners, and government agencies in Singapore but also internationally. Our overseas collaborations include teams from Stanford University, Massachusetts Institute of Technology, Cambridge University, Technical University Eindhoven, the French Grandes Écoles and Tsinghua University.
The Department is organized administratively into the following 7 research areas, namely, Control, Intelligent Systems & Robotics; Communications & Networks; Integrated Circuits & Embedded Systems; Microelectronic Technologies & Devices; Microwave & Radio Frequency; Power & Energy Systems; and Signal Processing & New Media. The focused research areas are as follows:

<table>
<thead>
<tr>
<th>Research Area</th>
<th>Major Research Topics &amp; Themes</th>
</tr>
</thead>
</table>
| Control, Intelligent Systems & Robotics            | • Precision Mechatronics  
• Advanced Process Control and Automation  
• Computational Intelligence and Applications  
• Advanced Robotics  
• Unmanned Aerial Vehicles  |
| Communications & Networks                          | • Network Architecture and Protocols  
• Wireless Transceiver Technology  
• Optical Communications Devices and Signal Processing  
• Sensor Networks  
• Energy Harvesting Communication Systems  
• Cloud Computing and Storage  |
| Integrated Circuits & Embedded Systems             | • Bio-electronics and Systems  
• Green Electronics  
• Integrated Systems for the Internet of Things  
• Mobile and Ubiquitous Computing  
• Flexible, Ingestible and Implantable Electronics  |
| Microelectronic Technologies & Devices             | • Spintronics and Nanomagnetics  
• Nanoelectronic Devices and Transistors  
• Photonics  
• Plasmonics  
• Micro- and Nano- Electromechanical Systems  
• Renewable Energy  
• Nanomaterials  |
| Microwave & Radio Frequency                        | • Design of Antenna and RF IC  
• Fast Computational Algorithms  
• Image Reconstruction Algorithms  
• Light-Matter Interaction  
• Microwave metamaterials and applications  
• Implantable and wearable RF and microwave devices  |
| Power & Energy Systems                              | • Power Electronics and Motor Drive Systems  
• Renewable Energy Sources and Integration with Utility Grid  
• Electrification of Transportation  
• Building energy system and dc microgrid  
• Smart Grid & Energy Management Systems  
• Computational Intelligence on Energy System Networks  
• Silicon and Wide Bandgap Power Semiconductors  
• Smart Power Integration Circuits and Power MEMS  |
| Signal Processing & New Media                       | • Machine Learning  
• Computer Vision & Image Processing  
• Neural Recording & Analysis  
• Computational Brain Imaging  
• Neuromorphic Sensing  
• Medical Imaging  
• Augmented Reality  
• Multimedia Processing  |
For further information on the above research areas and the research topics of individual staff, please visit our websites:

http://www.ece.nus.edu.sg/research/areas/
http://www.ece.nus.edu.sg/community/faculty/

Contact

For further information and contact details on our Ph.D/M.Eng programme, please visit our website:

http://www.ece.nus.edu.sg/education/graduate/PhD.html

or write to:

Graduate Program Manager
Department of Electrical and Computer Engineering
Faculty of Engineering, National University of Singapore
Block E4, Level 5, Room 45
4 Engineering Drive 3
Singapore 117576
Division of Engineering & Technology Management

The Division leads academic research in the broad areas of Technology Change, Innovation Policy, Innovation Strategy and Engineering Systems. As its nature is inter-disciplinary, our academic staff have research collaborators from different departments of engineering, as well as those from the School of Business. Adjunct professors from industry also enhance our programs with industry relevance and insights. The Division has also initiated strategic research collaborations with international partners on a project basis. These partners include academic staff from Johns Hopkins University, Tokyo Institute of Technology, Zhejiang University and National Chiao Tung University. The Division is also fortunate to attract several visiting professors from abroad and they bring years of experience, in either academia or industry, to enrich our research.

**Research in Technology Change** focuses on how industries emerge and evolve. We are particularly interested in how technological discontinuities and vertical disintegration emerge and their implications for both incumbents and entrepreneurs. This includes an understanding of the factors driving the emergence of discontinuities and vertical disintegration and the strategies for effectively dealing with them.

**Research in Innovation Policy** focuses on the dynamics of emergence and growth of high-tech industrial clusters, and the role played by Singapore as the innovation hub in Asia. The commercialization of university technology is new and it forms a major topic of our research in entrepreneurship. Special attention is paid to new areas such as Interactive and Digital Media, Solar Energy and Environmental Engineering.

**Research in Innovation Strategy** focuses on the study on barriers and facilitators of Discontinuous Innovation which drives company growth as well as entrepreneurship. In view of its importance in Singapore and Asia, a special research effort is expanded on Disruptive Innovation with regards to the fuzzy front-end challenge of creating disruptive technologies, relevant open innovation strategy, IP strategy, and development of appropriate core competence. The topic of secondary innovation focusing on process innovation in Singapore and China is also included. The theoretical understandings will be applied to identify innovation opportunities in new fields such as MEMS, OLEDs, Specialty Chemicals, Biomedical Devices, and Solar Cells.

**Faculty Members of the Division**

**Marcelo H ANG Jr PhD MS Rochester, MS Hawaii, BS De La Salle** Associate Professor
- Robotics
- Mechatronics
- Automation and computer control
- Applications of intelligent systems methodologies
- Creativity and Innovation

**Vladan BABOVIC Dip HE Delft, MSc IHE-Delft, PhD TU Delft and UNESCO-IHE** Associate Professor
- Systems architecting
- Real options
- Flexibility in Engineering Design
- Hydroinformatics
- Data mining and knowledge discovery

**Charanjit S BHATIA PhD MSc University of Minnesota** Professor
- Fabrication, characterization and performance of thin film Si Photovoltaic cells
- Technology road mapping & planning

**CHAI Kah Hin PhD Cambridge MEng UniSA BEng UTM** Associate Professor and Deputy Head
- New product development and innovation
- New service innovation and management
- Knowledge management and bibliometrics studies
CHAN Weng Tat PhD MSc Stanford, MEng BEng NUS Associate Professor

- Construction safety management systems
- System for technical innovation in engineering / planning work
- Trust attributes of engineering systems

FOO Maw Der, PhD MIT, University of Colorado Boulder Associate Professor

- Technology management
- Academic entrepreneurship
- Organizational behaviour
- Entrepreneurship

Michael FRESE PhD, TU Berlin, Diplom, Free University of Berlin, Vordiplom, University of Regensburg Professor (by Courtesy from NUS School of Business)

- Organizational behaviour
- Work psychology
- Training
- Entrepreneurship

Jeffrey Lee FUNK PhD MSc Carnegie Mellon, BSc California Polytechnic State Associate Professor

- Technology change and new industry creation
- How improvements in performance and cost occur
- Drivers of exponential improvements
- Sources of technological discontinuities
- Vertical disintegration and entrepreneurial opportunities

HANG Chang Chieh DSc PhD Warwick, BEng NUS Professor and Head of Department

- Innovation Strategy and Management
- Intellectual Properties and Innovation
- Framework for Analyzing Disruptive Technologies

Amit JAIN PhD Management INSEAD, MBA INSEAD, MSc (D.E.A.) Dip, Diplôme des Etudes Approfondies) with honors, Université de Paris, Dauphine, B. Tech., Mechanical Engineering, Indian Institute of Technology Assistant Professor

- Organizational learning and forgetting
- Change and inertia in organizations
- Technological change and innovation
- Firm boundaries

Luda KOPEIKINA MIT Sloan Fellow, Business Leader, Serial Entrepreneur & Investor, Visiting Professor

- Entrepreneurship as Management of Extreme Uncertainty
- Technology Commercialization
- Disruptive Innovation & Business Models
- Market Opportunity Identification & Validation Methodologies
- Engineering Leadership
- Frugal Innovation

Charles LEE Ph D & MSc University of Minnesota, BSc National Taiwan University Visiting Professor

- Entrepreneurship
- Technology valuation
- Global information technology businesses
- Cross-border relationships
- Venture capital
- Product development and marketing
- Business management
LIU Shang-Jyh  
*PhD Texas A&M  BS MS LLB National Taiwan, Visiting Professor*
- Legal, technological and managerial/economical aspects of intellectual property rights
- IP Intelligence and Technology Commercialization
- Competitive strategy and organizational management of high-tech industry

Annapoornima M. SUBRAMANIAN  
*PhD NUS, MSc IIT Kanpur, BSc Madras Christian College, Assistant Professor*
- Inter-organizational collaboration in high tech industries
- Managing knowledge (both tangible and intangible) in high tech industries
- Analyze innovations from emerging countries

Chihiro WATANABE  
*PhD BE Tokyo University Visiting Professor*
- Technology innovation management
- Techno-economics
- Technology innovation
- Technology policy
- Institutional innovation

WONG Poh Kam  
*PhD, E. Eng.,SM,SB MIT Professor (by Courtesy from NUS School of Business)*
- Economics and management of technological innovation
- Technology entrepreneurship
- National science and technology policy of East Asia countries
- East Asian Industrial Development Strategies

Wim VANHAVERBEKE  
*PhD IESE - Universidad de Navarra Visiting Professor*
- Open innovation
- Collaborative innovation
- Open business models & strategic innovation
- Corporate entrepreneurship
- Innovation management in SMEs
- Open innovation policy

**WHOM TO CONTACT**

For further information on the application procedure or departmental research activities, please contact –

Division of Engineering & Technology Management  
National University of Singapore  
Block EA, #05-34,  
9 Engineering Drive 1  
Singapore 117576

Phone: (65) 6516 8502  
Fax: (65) 6776 0755  
E-mail: etmcyy@nus.edu.sg

You can find out more about the Department and our academic staff at our Homepage:  
The Department’s research focuses in the following main areas; namely, Energy Systems, Maritime Logistics, Quality and Reliability, Optimization, Systems Modeling and Analysis, and Health Care Systems. While these research areas indicate the current strengths and future development of the Department, faculty members work closely together across research areas. Currently, the Department has collaboration with a number of research institutes such as The Logistics Institute - Asia Pacific (TLI - Asia Pacific), Temasek Defence Systems Institute, Energy Studies Institute and Centre for Maritime Studies. The Department also maintains strong ties with major industries with on-going collaborative projects in air and sea cargo operations, and quality and reliability issues in product design and manufacturing. Graduates of the Department are highly sought after by industry as prospective employment spans across manufacturing, logistics, finance, health-care and IT industries. Job titles of recent graduates include Industrial Engineer, Systems Engineer, Manufacturing Manager, Six Sigma Black Belt, Financial Engineer, Market Development Manager, Quality Manager, MIS Manager, Business Analyst, Logistics Engineer, Software Engineer, etc.

Research in Energy systems: Recent global concerns in energy security and environmental sustainability have spurred a growing need to develop energy systems that create more reliable and efficient energy supply. Operations research and systems engineering provide vital tools and models for analytics and policy-making in the energy arena. ISE faculty members have taken the lead on energy-related projects funded by universities, government agencies, and industry. This research program focuses on the operational management of energy systems, as well as the system aspects of energy efficiency and sustainability. Recent research projects include a study of the CO2 emissions indicator, an accounting system for tracking economy-wide energy efficiency trends, carbon pricing and industrial competitiveness, and management of energy resources in power generation systems. Several ISE faculty members are affiliated with the Energy Studies Institute (ESI), and have undertaken various projects sponsored by the Ministry of Trade and Industry and the Ministry of the Environment and Water Resources. This program exerts a high impact on national economic development and continues to generate new projects.

Research in Maritime Logistics: Singapore is located at the crossroads of major trade and shipping routes, and this has provided the opportunity for Singapore to become an International Maritime Centre. To tag on this national interest, one of our department’s key research thrusts is in Maritime Logistics. The main focus of this research program is to develop models and decision support tools to improve the efficiency and effectiveness for maritime operations, and conduct intelligent study on Maritime trends. The research activities include port benchmarking, port operation improvement and ocean liner operations. This research program supports and complements some of the works currently found in the university’s Centre for Maritime Studies (CMS), where some of the ISE faculty members are affiliates. They serve as track leaders in some of the CMS research clusters, namely the Port Operations Modeling & Analysis, Maritime Infrastructure Systems & Management and Marine Cluster Planning & Operations Management clusters. This research program has also received funding from the MPA, NOL fellowship and university to work on problems related to this area.

Research in quality and reliability has played an indispensable role in improving production processes and providing competitive edges in the manufacturing sectors over the past decades. Our department has a strong research team with many well recognized leaders in both academia and industry. Our research focuses include design-in quality & reliability, statistical optimization & control of complex processes, accelerated testing, software quality and reliability, etc. Our program is also actively promoting the applications of the state-of-art research in industries, and has successfully established collaborations and partnership with companies in semiconductor manufacturing, information technologies, etc. Additionally, in response to the fast development of nanotechnology and bioengineering in recent years, our department is also devoted to utilize our expertise in quality and reliability to help control and improve the highly variable processes, deploy (expensive) experiments to save cost and reduce development cycle, and scale up the processes to transform the lab technologies into mass production. Significant progresses have also been made in this new direction of quality and reliability research.

Research in Stochastic Modeling and Simulation: Many modern industrial and engineering systems are characterized by a high degree of uncertainty. The performance of these systems is heavily affected by volatile external processes, such as prices, demands, environmental conditions, and
others. Stochastic modelling helps us to capture the patterns and structures underlying these uncertainties, to analyse them in a rigorous way, and to predict future behaviours. Simulation models enable us to efficiently evaluate these complex systems and make decisions under uncertainty. The main focus of this program is to develop modelling and analysis methodologies for queueing models, discrete-event simulation, and simulation optimization. Much of the work by ISE faculty members focuses in these areas, and they have been working closely with industry; our industrial collaborators include MPA, IBM International Holdings, Hewlett Packard, and Proctor & Gamble. The methods developed by ISE faculty have been applied to areas such as maritime transportation, airport logistics, air cargo revenue management, warehouse order picking systems, and supply chain and inventory management in semiconductor manufacturing. These ongoing collaborations with industry continue to drive cutting-edge models and analytics with broad and general applicability.

Research in Optimization: Optimization has been and will remain a mainstay in operations research. Our research focuses on theory, algorithms, and applications in selected areas, including optimization under uncertainties and addressing difficult planning problems using mix of computation resources and optimization theories. On-going collaboration includes the last mile problem with Singapore-MIT Alliance for Research and Technology (SMART).

Research in Systems Modeling and Analysis: In systems research, one studies the underlying interactions between subsystems so as to understand the resulting dynamics of the overall system. This contrasts against the more traditional research methodology of divide-and-conquer. Such a system’s approach is necessary when (1) the dynamics at the system level is counter-intuitive and not easily explained, (2) trade-offs between subsystems, often involving conflicting objectives, are essential in the analysis, or (3) analysis at the subsystem level ignores crucial details, when the system is much more than the sum of the parts. The main focus in this line of research is to develop important insights and understanding in important subject matters using the system’s approach, and to improve on current system methodologies where necessary. On-going collaboration includes Future Urban Mobility with Singapore-MIT Alliance for Research and Technology (SMART), and environmental issues with Global Asia Institute (GAI).

Research in Health Care Systems: Health care systems have drawn increasing attention due to the growing pressures from an aging population. In this research program, we utilize the methodologies in operations research, applied probability and statistics, ergonomics, etc. to study health care systems from a holistic system engineering perspective. We focus mainly on developing novel machineries in public health policy making, health care resource planning and allocation, operation management and improvement, and necessary decision supports to facilitate medical diagnosis and treatments. We have made fruitful collaborations with the Ministry of Health, National University Hospital, Singapore General Hospital etc. on a variety of projects, with continuing efforts to further improve the health care systems in Singapore. In addition, the methodologies developed are also believed to be applicable to other service systems sharing similar characteristics.

Our Doctor of Philosophy (Ph.D) and Master of Engineering (M.Eng) programme is research based and provides rigorous training for our students. Candidates from science and engineering with outstanding first degrees and research potential and those with relevant master degrees are welcome to apply. You are welcome to contact potential advisors below.

**Faculty Members of the Department**

TANG Loon Ching  PhD MS Cornell, MEng BEng NUS  Professor and Head of Department
- Applied probability and statistics
- Quality and reliability engineering; Six sigma
- OR techniques for operational control and revenue management
- Queueing and its applications

ANG Beng Wah  PhD Cambridge, BSc Nan.  Professor
- Energy economics and policy
- Energy and climate change
- Energy efficiency potential study
- Development of energy and sustainability indicators
- Systems analysis and modelling
CARDIN Michel-Alexandre  PhD MS MIT, M.Applied Sc. Toronto, BS McGill  Assistant Professor
- Decision-making under uncertainty
- Flexibility in engineering design
- Real options analysis
- Engineering systems design
- Technology, management and policy

CHAI Kah Hin  PhD Cambridge, MEng UniSA, BEng UTM  Associate Professor
- New product management and innovation
- New service development and innovation
- Knowledge management
- Energy efficiency

CHEN Nan  PhD MS Wisconsin, BS Tsinghua University, Beijing  Assistant Professor
- System informatics and prognostic health management
- Performance modeling & surveillance of service systems
- Statistical quality & process control
- Applied statistics

CHEW Ek Peng  PhD MS Georgia IT, MEng BEng NUS  Associate Professor
- Port logistics and maritime transportation
- Simulation optimization
- Inventory management

GOH Thong Ngee  PhD Wisconsin, BE Sask.  Professor
- Analytics for quality, productivity and sustainability
- Design of experiments (DOE) for product and process optimization
- Quality methodologies: Six sigma, taguchi methods, robust design
- Systems engineering: Empirical modeling; decision making

HASKELL William Benjamin  PhD MA MS UC Berkeley  Assistant Professor
- Risk-aware decision making
- Sequential and large-scale optimization
- Data-driven decision making

HE Shuangchi  PhD Georgia Tech, PhD Auburn, MS BE Tsinghua  Assistant Professor
- Applied probability and statistics
- Stochastic modelling and queueing theory

LEE Loo Hay  PhD SM Harvard, BS Nat’l Taiwan  Associate Professor
- Simulation based optimization
- Port operations and maritime logistics
- Logistics and supply chain modelling

LIU Yang, PhD Northwestern, M.Phil. HKUST, B.S.Tsinghua University  Assistant Professor
- Transportation system modelling and analysis
- Transportation economics
- Sustainable transportation

NG Kien Ming  PhD MS Stanford, BSc NUS  Associate Professor
- Discrete and nonlinear optimization
- Scheduling and routing
- Timetabling
- OR methods in military
NG Szu Hui  PhD MS BS Michigan    Associate Professor
• Design of experiments
• Quality engineering
• Stochastic simulation
• Applied statistics

NG Tsan Sheng, Adam  PhD BEng NUS    Associate Professor
• Operations research in energy and sustainability
• Robust optimization
• System dynamics modelling and design

POH Kim Leng  PhD MS Stanford, MEng BEng NUS    Associate Professor
• Decision analysis and risk management in complex systems
• Engineering systems architecting under uncertainty
• Intelligent and adaptive decision support systems
• Large-scale systems optimization

TAN Chin Hon  PhD MS Florida, BEng NUS    Assistant Professor
• Optimization and decision making under uncertainties
• Markov decision processes and dynamic programming
• Applied probability

TAN Kay Chuan  PhD VPI, MS BS Mass.    Associate Professor
• Human-machine systems design, testing and evaluation
• Human-computer interaction
• Quality management especially of IT-based systems
• QFD and other quality measurement tools

THAM Ming Po    PhD MA UIUC, MS BA Calgary, Canada. Professor
• Human-centred design and engineering
• Operators’ performance in complex systems
• Team communication and collaboration in fast evolving environments
• Error analysis

YAP Chee Meng  PhD MS Pittsburgh., BEng NUS    Senior Lecturer
• Management of technology
• New product development management
• Financial impact of R & D investment

YE Zhisheng  PhD NUS, BEng Tsinghua    Assistant Professor
• Industrial statistics
• Complex systems modelling
• Reliability engineering

Who to Contact

Officer in-charge (Research Program)
Department of Industrial and Systems Engineering
Tel: (65) 6516 2206
Fax: (65) 6777 1434
E-mail: isebox10@nus.edu.sg
Web:  http://www.ise.nus.edu.sg
ABOUT OUR DEPARTMENT
Since the dawn of civilization, the power of understanding and using materials allowed human beings to progress steadily from the stone age to bronze age to iron age to the silicon age. Today, the “understanding” (fundamental science) and “using” (applied engineering) materials are transformed into a specialized niche yet interdisciplinary area known as Materials Science and Engineering. Currently, there are 14 faculty members and the department is presently actively recruiting world class academics. The number of academic staff within the Department will eventually rise to approximately 15-20; sufficient to reach the necessary critical mass for the Department to fulfill its mission. The anticipated size of the undergraduate enrolment is 50-70 students per year, along with a total number of postgraduate students in the region of 60. The Department enjoys a comprehensive research infrastructure with top-notch facilities for carrying out cutting-edge research and strives to provide graduate students with facilities and an environment that are conducive for creative and dynamic research. Many of the academic staff are internationally renowned in their fields and recent benchmarking of the research activities of the Department show it to be comparable to the best universities in the world.

DEPARTMENT’S SCOPE
The Materials Science and Engineering is a dynamic, interdisciplinary study that combines the fundamental sciences; chemistry, physics and life sciences; with the applied engineering; electronic, mechanical, chemical and bioengineering. It strives for basic understanding of how the science of structures and processes on atomic, nano- and micro- scales result in the properties and functions familiar at the engineering level. Materials scientists and engineers are interested in physical and chemical phenomena acting across large magnitudes of space and time scales. In this regard it differs from physics or chemistry where the emphasis is more on explaining the properties of pure substances. Likewise in materials science and engineering, there is also an emphasis on developing and using knowledge to understand how the properties of materials can be controllably designed by varying the compositions, structures, and the way in which the bulk and surface phase materials are processed during fabrication, this separates it from the other branches of engineering where the stress is on applications.

MAJOR RESEARCH & GRADUATE EDUCATIONAL THRUSTS
The Department pursues world class research and education in main stream areas of materials science and selected areas of engineering science relevant to Singapore. The Department’s activities are built on three major platforms, namely

- Infocom Technology
- Sustainable Energy
- Biotechnology
- Engineering materials

These platforms will enable the Department’s activities to adapt to the changing needs of the Singapore economy. The ultimate goal of the Department is in the integration of these three platforms into interdisciplinary niche areas for advanced scientific and engineering applications. The present niche areas are Nanostructured Materials / Biomedical Materials. In addition, the Department is fully aware of the importance of engineering materials in our economy.

1. Infocom Technology
Information and communications related industries play an important role in the Singapore economy. This vital area is expected to continue to grow with the introduction of new devices and applications, without doubt advanced materials and sophisticated materials processing techniques will be at the heart of all this new innovations. The faculty members in Department of Materials Science and Engineering have demonstrated a strong track record in the research of infocom related materials. Strategic areas include electronics, sensors, and data storage. Current research topics include: (1) Electronic properties of self-assembled quantum dots, (2) Development of advanced magnetic

2. Sustainable Energy
There is an increasing need to find environmentally friendly replacements for fossil fuels. This is especially true in Singapore with its high population density. Presently the most promising sources for sustainable primary energy are hydroelectric, solar power, wave power and wind power. Unfortunately only the second of these, solar power, is likely to be practical in Singapore. Furthermore in order for these primary sources to truly replace fossil fuels, there a need to develop transportable secondary power sources; most notably fuel cells, advanced batteries and techniques for safe hydrogen storage. The development of environmentally friendly advanced materials is the key to all these sustainable energy systems. The Department is currently working in the areas of: (1) Advanced lithium batteries, (2) dye sensitized solar cell, (3) the dynamics of disordered materials in relation to sustainable energy, (4) Thin film and Bulk nanostructured mesoporous materials, (5) Advanced thin film photovoltaic materials, and (6) Novel semiconductor thick film solar cells.

3. Biotechnology
Materials which are used in the human body are generally known as biomedical materials. In recent years there have been tremendous advances in the fields of chemistry, physics, biology and engineering which have a direct impact on advances in biomaterials science. Many areas of healthcare depend upon the development of novel biomedical materials. Examples include bone graft substitutes, dental materials, biosensors, and materials for controlled delivery of drugs and synthetic genes. The Department of Materials Science and Engineering plans to be in the vanguard of developments in Biomedical Materials with a platform for high quality, interdisciplinary research. Currently, the Department has a number of research groups working on the following areas: (1) Biosensors, (2) Biomagnetism, (3) Corrosion & degradation of surgical implants, (4) Advanced simulation of cell deformation, (5) Modelling of adhesion on cell membranes (6) Surface and bulk characterisation of biomolecules and (7) Nanosized particles for drug delivery.

4. Engineering Materials
Many staff members are very active in research work that is closely related with industrial applications. We are working on advanced materials fabrication techniques and functional devices that have great potential in commercialization. The current running research projects are: advanced materials manufacture (including 3D printing of metal and ceramics), composite materials, corrosion prevention, multi-functional devices (including gas sensor, battery, supercapacitor, MEMS etc.)

**WHOM TO CONTACT**

For further information on the application procedure or departmental research activities, please contact -

Department of Materials Science & Engineering
National University of Singapore
7 Engineering Drive 1
Block EA, #03-04
Singapore 117574
Phone: (65) 6516 5192
Fax: (65) 6776 3604
E-mail: msebox6@nus.edu.sg

You can find out more about the Department and our academic staff at our Homepage: Materials Science & Engineering home page: www.mse.nus.edu.sg
Graduate Research & Scholarship page: http://www.gse.nus.edu.sg/postgradprog.html
ACHIEVEMENTS AND STRENGTHS

The Department of Mechanical Engineering comprises six academic groups, namely, Applied Mechanics, Control & Mechatronics, Energy & Bio-Thermal Systems, Fluid Mechanics, Manufacturing and Materials. The Department emphasises multidisciplinary research activities and has consolidated major research efforts with strategic thrusts in areas such as Energy Systems, Future Transportation, Micro-Nano Materials and Systems, Engineering in Medicine and Offshore & Subsea Engineering.

The vibrant research environment of the Department continues to attract and sustain funding from both the public and private sectors. There are currently over 100 ongoing funded research projects with a total funding of about $53.23 million. Our research collaborators include companies, organizations and universities, such as A*Star, MOE, NRF, NMRC, DSTA, MOH, TDSI, SimTech, Qatar Foundations; ST Kinetics, SIA, NUH, PUB, DSI, Penn State, IME, DSO, MIT, UCL, Stanford University, Tennessee Tech, Indian Institute of Science, JHU, GreenZone Pte Ltd, Brown University, University of Basel, Purdue University, Peking University, Universitas Indonesia, NIWA, and TsingHua University.

The academic staff strength of the Department grew to its current number of 62 at the end March 2015. Many staff members have taken on the roles of principal investigators and key collaborators in research projects. Research efforts are supported by about 112 research staff, 43 technical support staff, and 243 graduate students (PhD and MEng). Emphasis is placed on training high-quality graduates with a strong background and depth in engineering fundamentals. The Department also seeks to develop their critical thinking skills to enhance their ability to contribute to the advancement of science and technology and to Singapore’s economic development. The distinguished faculty members and motivated students have continued to raise the international standing of the Mechanical Engineering Department.

The Department has also produced several spin-off companies such as

- Manusoft Technologies Pte Ltd which develops and markets IMOLD for the design of plastic injection molds;
- Mikrotools Pte Ltd which develops and manufactures advanced machine tools and systems for ultra-precision and micro-machining applications;
- Electrospunra Pte Ltd which specializes in the design and development of nanofiber manufacturing machines and novel nanomaterials for energy, water, environment, and health care applications;
- Gatekeeper Laboratories Pte Ltd which provides solutions to wean computers and other hardware from their reliance on heat-pipe cooling;
- NanoThree Pte Ltd which developed and patented a breakthrough gas/water mixing technology for the emerging ballast water treatment market. Armed with this technology, NanoThree seeks to serve the needs of ship owners, manufacturers and retrofitters;
- GCoreLab Private Ltd, a dedicated Singapore based clean tech thermal management company, is engaged in the research and development of thermal management system for the next generation of electrical vehicles; and
- Medad Technologies’s energy recovery desalination system based on hybridized Adsorption technology is a world’s first.

AREAS OF RESEARCH

Applied Mechanics and Applied Biomechanics
Acoustic, dynamics & guidance, plasticity, fracture and impact mechanics, NDT and evaluation, multi-scale mechanical modelling (macro to molecular), mechanical behaviour of materials, constitutive modeling, damage mechanisms in composite materials, biomechanics, mechanobiology, micro-electro-optical mechanical systems, computational mechanics.

Control, Robotics and Mechatronics
Robust control, machine learning, optimization, data analytics, human-robot collaborative systems, legged robots, mobile robotics, rehabilitation and haptic devices, medical robotics, autonomous systems, biomimetics, micro-manipulation, Computer vision and graphics.
Energy & Thermal Systems
Energy management for buildings, solar-powered adsorption desalination, co-generation power plants, drying technologies, electronic packaging and cooling, micro power sources, micro-channel cooling and boiling Thermo-electric systems.

Fluid Mechanics and Aerodynamics
Bluff body aerodynamics, unsteady aerodynamics, flapping-wing aerodynamics and flyers, flow stability & transition, vortex dynamics, turbulent drag reduction, micro-bubble & droplet dynamics, cavitation, shock and detonation, pulse detonation engine, bioluid-dynamics, microfluidics, fluid transient in pumping systems, computational fluid dynamics research.

Manufacturing
Micro- and nano-machining, micro fabrication, micro-machining centres, distributed design & manufacturing systems, neuro-sensors, magnetic sensors for defence applications, assistive technology systems and devices, Processing of powder metallurgical materials, rapid design and prototyping systems and materials, process monitoring, fault recovery and diagnostics.

Materials
Advanced Processing, Designing, Modelling and Characterization of Futuristic Materials including: Cost effective and energy efficient processing of lightweight metal based (Al, Mg) materials focussing on (nano) composites, Advanced Scanning Probe Microscopy Characterization, Biomimetics, lithium ion and post-lithium electrochemical batteries, supercapacitors, computational materials modelling and design, carbon-based fibers and aerogels, electrospun nanofibers and nanoparticles, Tribology.

ACADEMIC STAFF

<table>
<thead>
<tr>
<th>APPLIED MECHANICS</th>
<th>CONTROL &amp; MECHATRONICS</th>
<th>ENERGY &amp; BIO-THERMAL SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/Prof CHAU Fook Siong</td>
<td>A/Prof ANG Jr, Marcelo H</td>
<td>Prof CHOU Siaw Kiang</td>
</tr>
<tr>
<td>A/Prof JOSHI Shailendra Pramod</td>
<td>A/Prof CHEN Chao Yu, Peter</td>
<td>Dr CHUA Kian Jon, Ernest</td>
</tr>
<tr>
<td>Dr KOH Soo Jin, Adrian</td>
<td>A/Prof CHEW Chee Meng</td>
<td>Dr KOH Yee Kan</td>
</tr>
<tr>
<td>A/Prof LEE Heow Pueh</td>
<td>A/Prof CHUI Chee Kong</td>
<td>A/Prof LEE Poh Seng</td>
</tr>
<tr>
<td>A/Prof LIM Kian Meng</td>
<td>A/Prof HONG Geok Soon</td>
<td>Prof NG Kim Choon</td>
</tr>
<tr>
<td>Dr ONG Eng Teo</td>
<td>A/Prof LIM Kah Bin</td>
<td>A/Prof PALANI Balaya</td>
</tr>
<tr>
<td>A/Prof QUAN Chenggen</td>
<td>A/Prof ONG Chong Jin</td>
<td>Dr PARK Sungyong</td>
</tr>
<tr>
<td>Prof SHIM Phuyu Wui, Victor</td>
<td>A/Prof TEO Chee Leong</td>
<td>Dr YANG Wenming</td>
</tr>
<tr>
<td>A/Prof TAN Beng Chye, Vincent</td>
<td>Dr VELUSAMY Subramaniam</td>
<td>A/Prof YAP Christopher</td>
</tr>
<tr>
<td># Prof TAY Tong Earn</td>
<td>Dr XU Huan</td>
<td></td>
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<tr>
<td>A/Prof ZHOU Guangya</td>
<td>Dr ZHU Jian</td>
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<td>Dr ZHU Jian</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>FLUID MECHANICS</th>
<th>MANUFACTURING</th>
<th>MATERIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr ESTRUCH-SAMPER, David</td>
<td>Prof FUH Ying Hsi, Jerry</td>
<td>Dr DUONG Hai Minh</td>
</tr>
<tr>
<td>Dr JAIMAN Rajeev Kumar</td>
<td>Dr GOH Seach Chyr, Ernest</td>
<td>A/Prof GUPTA, Manoj</td>
</tr>
<tr>
<td>Prof KOH Boo Cheong</td>
<td>A/Prof KUMAR A Senthil</td>
<td>A/Prof LIM Yui Hung, Christina (Ms)</td>
</tr>
<tr>
<td>A/Prof KIM Taetylou, John</td>
<td>A/Prof LEE Kim Seng</td>
<td>Prof LU Li</td>
</tr>
<tr>
<td>Prof LIM Tee Tai</td>
<td>Prof LI Xiaoping</td>
<td>Dr MANZHOS, Sergei</td>
</tr>
<tr>
<td>A/Prof LOH Wai Lam</td>
<td>A/Prof LU Wen Feng</td>
<td>Prof SEERAM Ramakrishna</td>
</tr>
<tr>
<td>A/Prof LOW Hong Tong</td>
<td>A/Prof ONG Soh Khi (Ms)</td>
<td>Dr THIAN Eng San</td>
</tr>
<tr>
<td>Dr LUA Kim Boon</td>
<td>Prof SEAH Kar Heng</td>
<td>A/Prof ZENG Kaiyang</td>
</tr>
<tr>
<td>Prof PHAN-THIEN Nhan</td>
<td>A/Prof TAY Eng Hock, Francis</td>
<td></td>
</tr>
<tr>
<td>Prof SHU Chang</td>
<td>Prof WONG Yoke San</td>
<td></td>
</tr>
<tr>
<td>Dr TAN Danielle Sweimann (Ms)</td>
<td>A/Prof ZHANG Yunfeng</td>
<td></td>
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<tr>
<td>A/Prof TEO Chiang Juay</td>
<td></td>
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<tr>
<td>A/Prof YEO Khoon Seng</td>
<td></td>
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</tr>
</tbody>
</table>

#     Head of Department
WHO TO CONTACT:

For information on application procedure or department research activities, please contact:-

Programme Manager (Research)
Department of Mechanical Engineering
National University of Singapore
Block EA, #07-08
9 Engineering Drive 1
Singapore 117576
Phone : (65) 6516 6800
Fax : (65) 6779 1459
E-mail: mpeask@nus.edu.sg

Website Address: Mechanical Engineering home page: http://me.nus.edu.sg
The Application Material

Application Form

The application material comprises the following:

- this application booklet
- application fee form
- application checklist
- application form
- overseas interview form
- transcript request form
- referee’s report (2 copies)

Candidates who wish to apply for more than one programme are required to submit separate sets of application forms. Each set of application form should be accompanied by all the documents outlined in the application checklist.

Any omission of information requested in the application forms or supporting documents will render the application form void and therefore should be avoided.

Documentary Evidence

Applicants should submit an official transcript of academic records from each university attended. You are responsible for requesting your transcript from the university concerned. Graduates from this University can submit certified copies of the official transcripts of their academic records with their applications. For foreign graduates, the official transcript must be enclosed in a SEALED envelope with its flap bearing the security seal of the University and the signature of the Registrar or his representative. All documents should reach us no later than the stipulated closing dates.

Supporting documents, if not in English, should be accompanied by copies of the English translation of the documents.

TOEFL and GRE Tests

The quantity and quality of academic work at NUS cannot be accomplished without mastery of the English language. This point is deliberately emphasized because graduate students at NUS submit regular reports, take written examinations and are expected to participate actively in classroom discussions. International applicants may demonstrate their English proficiency by means of TOEFL/IELTS and GRE/GATE test scores. The scores submitted will be taken into consideration as part of admission processing.

Applicants can either:
(a) submit TOEFL and GRE scoresheets certified by their Universities with an original stamp; or
(b) request the NUS Department to certify their scoresheets if they are in Singapore; or
(c) request Educational Testing Services (ETS) to send original TOEFL and GRE scores to NUS. (Scores should be sent to the Department in which the applicant is interested in pursuing his/her research. Institution code of NUS is 0677 [for GRE] and 9084 [for TOEFL] and with specific department code).

Graduates from Indian Universities may send either GRE or GATE scoresheets.

Applicants who graduated from English-medium universities and have yet to sit for the tests, may be required at the discretion of the Department/Division Head or Vice-Dean (Graduate Programmes), Faculty of Engineering, to undergo such tests as may be set to assess their suitability for University study and to appear for interviews.
Overseas Interview

Overseas interviews will be conducted for shortlisted international applicants applying for the NUS Research Scholarship and/or admissions. These interviews are expected to be held in February/March (for August intake) and August/September (for January intake). Applicants will be notified via email about two weeks prior to the interviews. Applicants should update the University of any changes to their email addresses.

Referee’s Reports

Recommendations from 2 academic referees are required for the application. Please use the referee reports in the application package. Kindly ask your referees to send us their reports enclosed in **sealed** envelopes whose openings bear their signatures (and to indicate your name clearly). The University may write to the academic referees for further information.

Closing Dates

All applications must reach the Departmental Offices by the following dates:

<table>
<thead>
<tr>
<th>Applicants and Closing Dates</th>
<th>August 2016 Intake</th>
<th>January 2017 Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>• For <strong>international</strong> applicants; &amp;</td>
<td>1 November 2015</td>
<td>15 May 2016</td>
</tr>
<tr>
<td>• For <strong>applicants residing in Singapore</strong> and applying for the <strong>NUS Research Scholarship</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• For <strong>applicants residing in Singapore</strong> and applying for <strong>admission</strong> (without scholarship) only</td>
<td>1 April 2016</td>
<td>1 September 2016</td>
</tr>
</tbody>
</table>

* For example:
(1) NUS/NTU graduates; or (2) graduates of other universities and whose domicile is Singapore etc

Submission of Application

Completed applications should be submitted directly to the **individual divisions/departments**. Please refer to the Annex for their mailing address.

Confirmation of Application

Due to the large number of applications received for each intake, enquiries for the delivery or receipt of application packages/supporting documents will not be entertained. The Department will acknowledge your application via email when they process your application and will inform you of any outstanding forms or documents and when you may expect to hear from us on the outcome of your application.

Notification of Application Results

You will be notified of the results of your applications from May 2016 and October 2016 if you are applying for the August 2016 Intake and January 2017 Intake respectively. Due to the large number of applications received, we regret that no enquiries will be entertained. We will notify you of the result by email. Alternatively, you may log into the online application system (for those who have submitted online application) to check your application status.
Listing of Publications (Format)

If you have any publications, please complete Section (7) of the application form and enclose a copy of each publication. When listing your publications, please follow the format below:

**BOOK**

<table>
<thead>
<tr>
<th>Author</th>
<th>Title of book</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total No. of Pages</th>
<th>Place of Publisher</th>
<th>Publisher</th>
</tr>
</thead>
</table>

**ARTICLE IN BOOK**

<table>
<thead>
<tr>
<th>Author</th>
<th>Title of Publication</th>
<th>Source</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Editor</th>
<th>Pages nos. of contribution in book</th>
<th>Place of Publication</th>
<th>Publisher</th>
</tr>
</thead>
</table>

**CONTRIBUTION IN JOURNAL**

<table>
<thead>
<tr>
<th>Author</th>
<th>Title of paper</th>
<th>Source</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Vol. No.</th>
<th>Serial/Issue no.</th>
<th>Page nos.</th>
<th>Place of publication</th>
</tr>
</thead>
</table>

**REVIEW**

<table>
<thead>
<tr>
<th>Author</th>
<th>Article reviewed</th>
<th>Editor of article</th>
<th>Source</th>
</tr>
</thead>
</table>

|----------|------------------|-----------|
**THESIS**

<table>
<thead>
<tr>
<th>Name of postgraduate student</th>
<th>Title of thesis</th>
</tr>
</thead>
</table>

**CONFERENCE PAPER**

<table>
<thead>
<tr>
<th>Author</th>
<th>Title of paper</th>
<th>Full title of published proceedings</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Venue of conference</th>
<th>Vol. No.</th>
<th>Page nos.</th>
<th>Country of publication</th>
<th>Publisher</th>
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</thead>
</table>

**EDITING WORK FOR BOOK**

<table>
<thead>
<tr>
<th>Editor</th>
<th>Title of book</th>
<th>Place of publication</th>
<th>Publisher</th>
</tr>
</thead>
</table>

| Total no. of pages | |

**OCCASIONAL PAPER**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title of paper</th>
<th>Publisher</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Paper no.</th>
<th>Total no. of pages</th>
</tr>
</thead>
</table>
GUIDE FOR INTERNATIONAL STUDENTS

Immigration
To apply for a Student’s Pass, a foreign student must first be accepted and offered a place as a full-time matriculated or registered student. New applications for a Student’s Pass must be submitted at least one month and not more than 2 months before the expected date of matriculation as an NUS student. Applications must be submitted through the Student’s Pass On-Line Application & Registration (SOLAR) system https://solar.ica.gov.sg/solar/index.xhtml

NUS will initiate a registration with ICA for your Student’s Pass on your behalf. You will receive an email instruction from NUS to submit eForm16. The student may login to SOLAR to submit eForm 16. Applicants must have the following information before logging into SOLAR:

- A registration acknowledgement notice with the login information provided by the University’s Registrar’s Office;
- Travel document/passport details (including travel document/passport number, date of expiry, etc);
- NRIC/FIN of parents if the student’s parents are Singaporeans or foreigners who are working or residing in Singapore;
- Singapore’s address and contact details (if not available, please provide the school’s registered address); and
- Applicant’s email address.

- One recent passport-sized colour photograph (to be pasted on the top-right corner of eForm 16) and must meet the following requirements:
  - Image must be taken within the last 3 months
  - Photograph should be in colour, must be taken against a white background with a matt or semi-matt finish
  - Image must show the full face and without headgear (headgear worn in accordance with religious or racial customs is acceptable but must not hide the facial features

Upon submission of the eForm 16 through SOLAR, students are required to print a copy of the eForm for submission to the Student’s Pass Unit, Immigration & Checkpoints Authority (ICA), to complete formalities for the issuance of a Student’s Pass (if the application is successful).

ICA may request some applicants to furnish additional documents in support of the application, where necessary.

The processing time is 5 full working days for foreigners who do not require a visa to enter Singapore. For foreigners who require a visa to enter Singapore, the processing time is 10 full working days. Some applications may take a longer time to process.

Successful applicants will be issued with an in-principle approval (IPA) letter by ICA through the University. For applicants who require a visa to enter Singapore, a visa will be incorporated in the IPA letter. Students need not apply for a separate visa and may enter Singapore by producing the IPA letter at the checkpoints.

On arrival in Singapore, students are required to report to the Student’s Pass Unit, 4th floor, ICA Building, for completion of formalities for the issuance of a Student’s Pass within the duration of the social visit pass granted at the checkpoint.

Students are required to furnish the following documents for completion of formalities:

- The student’s valid passport. A copy of the passport particulars page must be submitted;
- The Disembarkation/Embarkation card of the student, granted on entry into Singapore. If the student is currently residing in Singapore on other long term passes, he/she is required to bring along that pass;
- One recent colour passport-sized photograph (taken on white background);
- The printout of eForm 16 submitted through SOLAR (duly signed by the applicant);
- A copy of the in-principle approval letter; and
- A medical report in the prescribed format (available on ICA’s website).
The medical examination can be done in the student’s home country if he/she has never resided in Singapore on any long term immigration passes previously. However, it must be done on the prescribed medical report form and submitted with the relevant laboratory reports. An official translation of the laboratory reports is required if it is not in the English language. At the time of submission, the laboratory reports must not be more than 3 months from the date of issue. Students who failed to fulfill the medical requirements will not be issued with a Student’s Pass.

For the application of Student's Pass, a processing fee of S$30 will be collected at the time of submission. The fee collected is non-refundable regardless of the outcome of the application or if you have withdrawn the application after submission. For submission via SOLAR, please make payment by credit/debit card or internet banking.

For the Student Pass to be issued, an issuance fee of S$60 will be collected. A further $30 multiple-entry visa fee will be charged for visa required nationals. The fee will be collected at the time of collection.

Please note that prior to collection of Student's Pass, applicant has to bring along a signed copy of the Terms & Conditions for Student’s Pass (STP) Card”. Please click http://www.ica.gov.sg/data/resources/docs/Visitor%20Services/Terms_and_Conditions_STP.pdf for copy of the form.

**Students Accompanied by Spouse**
The Office of Student Affairs (OSA) provides assistance to international students in their application of their student’s pass but does not provide sponsorship of any kind. For students receiving the NUS Research Scholarship (i.e. research scholars) and are accompanied by their spouse, Registrar’s Office (RO) will sponsor the spouse for a social visit.

For more information:

i) on application for student pass, please email international@nus.edu.sg or check website at http://nus.edu.sg/osa/iss

ii) on sponsorship conditions and clarifications, please contact the Registrar's Office at 6516 2302 or gdhelp@nus.edu.sg or check the website at: http://www.nus.edu.sg/registrar/event/socialvisitpass.html

iii) on immigration matters, please contact Immigration and Checkpoints Authority (ICA) at Tel: 6391 6100 or check the website at http://www.ica.gov.sg/index.aspx

Immigration and Checkpoints Authority (ICA) is located at:

**Immigration and Checkpoints Authority Building**
10 Kallang Road
Singapore 208718

Operating hours:
Mon – Fri : 8am – 5pm
Sat : 8am – 1pm

**Immigration Enquiry Service**
Tel : 6391 6100

Transport Services to ICA :
MRT - Alight at Lavendar MRT Station
Bus No. 7 - From Clementi Bus Interchange
Bus 33 - From Kent Ridge Bus Terminal
Bus 145 - From Clementi Avenue 2 (near the Mosque)
Bus 197 - From Ayer Rajah Expressway
### Estimated Cost of Living

In addition to the research and miscellaneous fees, an international graduate student can expect to incur the following expenses:

<table>
<thead>
<tr>
<th>Expenditures (Per Month)</th>
<th>Amount in S$ (approximately)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accommodation</strong></td>
<td></td>
</tr>
<tr>
<td>NUS Graduate Student Residences</td>
<td></td>
</tr>
<tr>
<td>Off-Campus: Boon Lay - Double Occupancy</td>
<td>From $1600 (per semester)</td>
</tr>
<tr>
<td>On-campus: PGPR Graduate Student Apartments</td>
<td>From $4320 (per semester)</td>
</tr>
<tr>
<td>University Town Graduate Residence</td>
<td>From $2520 (per semester)</td>
</tr>
<tr>
<td><strong>Off-campus Private Accommodation</strong></td>
<td></td>
</tr>
<tr>
<td>Room rental</td>
<td>$400 - $600</td>
</tr>
<tr>
<td>Apartment rental</td>
<td>$1800 - $2500</td>
</tr>
<tr>
<td><strong>Food</strong></td>
<td></td>
</tr>
<tr>
<td>University Canteens/Food Courts</td>
<td>$250 - $350</td>
</tr>
<tr>
<td>Meals outside campus</td>
<td>$500 - $600</td>
</tr>
<tr>
<td><strong>Books/Supplies</strong></td>
<td></td>
</tr>
<tr>
<td>(depends on course of study)</td>
<td>$150 - $200</td>
</tr>
<tr>
<td><strong>In-country transportation</strong></td>
<td></td>
</tr>
<tr>
<td>Public bus/MRT</td>
<td>$150 - $250</td>
</tr>
<tr>
<td><strong>Personal expenses</strong></td>
<td></td>
</tr>
<tr>
<td>(Toiletries, clothing, miscellaneous)</td>
<td>$200 - $250</td>
</tr>
<tr>
<td><strong>Estimated Cost of Living</strong></td>
<td><strong>$2,500 - $3,000</strong></td>
</tr>
</tbody>
</table>

Note: The costs have been derived based on a conservative estimate for a reasonably comfortable lifestyle. The actual amount could be higher or lower depending on the individual student’s expenditure and lifestyle pattern. For graduate students whose spouses are also living here, the expenses would be approximately twice as much.

### Accommodation

The Office of Student Affairs (OSA) will provide assistance in accommodation. All enquiries about accommodation should be directed to:

Hostel Admissions Services  
Office of Student Affairs, Student Service Centre  
National University of Singapore  
Yusof Ishak House, Level 1  
31 Lower Kent Ridge Road  
Singapore 119078  
Tel: (65) 6516 1384  
Fax: (65) 6777 0155

Further information on international student services provided by OSA is also available from [http://nus.edu.sg/osa/home](http://nus.edu.sg/osa/home)
Departments'/Divisions' Mailing Addresses

Please mail your application(s) to the respective Departments/Divisions.

Department of Biomedical Engineering
National University of Singapore
4 Engineering Drive 3, Block E4 #04-08
Singapore 117583

Department of Chemical & Biomolecular Engineering
National University of Singapore
4 Engineering Drive 4, Block E5 #02-09
Singapore 117585

Department of Civil & Environmental Engineering
National University of Singapore
1 Engineering Drive 2, Block E1A #07-03
Singapore 117576

Department of Electrical & Computer Engineering
National University of Singapore
4 Engineering Drive 3, Block E4 #05-45
Singapore 117583

Division of Engineering & Technology Management (D-ETM)
National University of Singapore
9 Engineering Drive 1, Block EA #05-34
Singapore 117575

Department of Industrial & Systems Engineering
National University of Singapore
1 Engineering Drive 2, Block E1A #06-25
Singapore 117576

Department of Materials Science & Engineering
National University of Singapore
9 Engineering Drive 1, Block EA #03-09
Singapore 117575

Department of Mechanical Engineering
National University of Singapore
9 Engineering Drive 1, Block EA #07-08
Singapore 117575
<table>
<thead>
<tr>
<th>Department/Division/Programme Office</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of Graduate Programmes, Faculty of Eng ①</td>
<td>EA 06-16</td>
</tr>
<tr>
<td>Biomedical Eng ③</td>
<td>E4 04-08</td>
</tr>
<tr>
<td>Chemical &amp; Biomolecular Eng ④</td>
<td>E5 02-09</td>
</tr>
<tr>
<td>Civil &amp; Env Eng ②</td>
<td>E1A 07-03</td>
</tr>
<tr>
<td>Electrical &amp; Computer Eng ③</td>
<td>E4 05-45</td>
</tr>
<tr>
<td>Engineering &amp; Technology Management ①</td>
<td>EA 05-34</td>
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<tr>
<td>Industrial &amp; Systems Eng ②</td>
<td>E1A 06-25</td>
</tr>
<tr>
<td>Materials Science &amp; Eng ①</td>
<td>EA 03-09</td>
</tr>
<tr>
<td>Mechanical Eng ①</td>
<td>EA 07-08</td>
</tr>
<tr>
<td>University Health Centre ⑤</td>
<td></td>
</tr>
<tr>
<td>- UHC Clinic (medical examination)</td>
<td></td>
</tr>
<tr>
<td>Yusof Ishak House ⑥</td>
<td></td>
</tr>
<tr>
<td>▪ Level 1 : Student Service Centre (paying fees)</td>
<td></td>
</tr>
<tr>
<td>▪ Level 3 : Office of Student Affairs</td>
<td></td>
</tr>
<tr>
<td>C1 Engineering Canteen</td>
<td></td>
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<tr>
<td>EW1 Engineering Workshop 1</td>
<td></td>
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<tr>
<td>EW2 Engineering Workshop 2</td>
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</tbody>
</table>

For the latest campus map, please check the NUS website at [http://www.nus.edu.sg/campusmap/](http://www.nus.edu.sg/campusmap/)

For all internal shuttle bus services, please check the NUS website at [http://www.nus.edu.sg/oca/Transport-and-Parking/Getting-around-NUS.html](http://www.nus.edu.sg/oca/Transport-and-Parking/Getting-around-NUS.html)