The Mission of ESP

The Engineering Science Programme (ESP) was launched in April 2006 as a flagship educational initiative from the faculties of Engineering and Science at NUS. The main mission of ESP is to prepare students for careers in Research and Development, whether be it in industry or academia. The programme aims at combining strong science fundamentals with cutting edge engineering applications, so that ESP graduates can effectively contribute to solving the many complex multi-disciplinary challenges of our time, such as problems in communication, transportation, energy production, health, security, and environmental pollution.

Job Opportunities

According to a recent Ministry of Education surveys, our ESP graduates have relatively high starting salaries [1]. There is currently, a great demand for all kinds of engineers. Beyond the traditional engineering disciplines, such as civil, electrical, mechanical, chemical, industrial, engineering is rapidly growing in new fields, such as medicine, biology and the environment. All are needed, and there are plenty of jobs to go round. Our Engineering Science graduates have been successful in finding jobs in a wide-variety of different ways. Some find jobs in traditional engineering disciplines, such as electrical power distribution. Others go to the newer high tech multi-disciplinary industries, companies in alternative energy technologies (e.g., solar cells), in medical, communications and semiconductor industries. Quite a few ESP graduates have found jobs with government research centres such as DSO and A*STAR research institutes. A significant number of ESP graduates have started up their own companies, and many have gone on to do further studies, both in Singapore and prestigious universities such as Harvard University and MIT. Our graduates have found jobs in a wide variety of places.
What helps you find a job?

Prospective ESP students should bear in mind that employers take into account many factors when deciding whether to employ a university graduate, beyond which courses he or she has studied. Since the cohort size of ESP is deliberately kept small (limited to approximately between 30 to 50), the programme has built up a closely-knit team of high quality academic staff, ESP students receive a lot of personal attention, and this helps them have greater hands-on experience and develop their own individual passion and interest. ESP students will receive an undergraduate education that is strong in the following areas.

First-hand experience and a hands-on education
An employer will ask you about the hands-on things you have done, the things that are in your first-and experience. Employers can easily tell the difference between second-hand knowledge and first-hand experience. They will ask you about your projects, they will generally not ask too much about specific courses and grades.

Passion and interest
Employers want to have employees who are passionate and interested in what they do. Passion and interest is your most secure strategy for a successful career, take the time to develop passion and interest in a field of study during your university career. Take the time and interest to find out what it is that you are most interested in.

Strong scientific fundamentals
In a landscape of fast changing technologies, it is very important to be strong in scientific fundamentals. This is essential if you intend to work in the R&D sector, often required in order to innovate in engineering.

A multi-disciplinary approach
More and more employers these days are requesting for a multi-disciplinary education. Graduates must be prepared to be more flexible in what they can work on; graduates are now expected to change jobs several times during their careers. Also, engineering devices and products are becoming more and more multi-disciplinary in character, and the experience in several different disciplines is very much appreciated by employers.
Engineering Science Programme and STEM

The acronym, “STEM”, which stands for Science, Technology, Engineering and Mathematics, is becoming increasingly used in the fields of education and the job market. It was first used in the context of developing a broader type of primary/secondary school education in the US [2], but is now widely used in the context of highlighting the kind of education graduates need in order to be prepared for the future. In a speech made by Prime Minister Lee Hsien Loong on 8th May 2015, he stressed that in order to develop its economy and to become a modern and technologically advanced society, Singapore will need to grow its talent and capabilities in the fields of Science, Technology, Engineering and Mathematics or STEM. He said: “... For the next 50 years, we need strong STEM capabilities to be what we should be – a vibrant, exciting, advanced society. Recently I launched the Smart Nation programme to make Singapore a nation where technology and innovation strengthens our community and society, and enables people to live meaningful and fulfilled lives. There will be many opportunities for STEM graduates to make your mark and shape how we live, work and play. We are also upgrading our living environment – building greener homes, connecting our waterways and parks, expanding our public transport networks, embarking on complex engineer projects like the High Speed Rail link between Jurong East and Kuala Lumpur. All these require expertise and skills in engineering, technology and design.” [3]

The Engineering Science Programme at NUS is focused on providing a hands-on engineering multi-disciplinary “STEM” type of education that is founded on strong scientific/mathematical fundamentals. There are clear indications that a graduate with this kind of education will do well in the job market now and for the foreseeable future.

The ESP specialisations and the RIE 2020 Plan

After taking two years of foundation courses, ESP students will have the opportunity to specialise in one of the four subjects:

1) Nanoscience and Technology
2) Energy Science and Technology
3) Computational Engineering Science
4) Photonics and Optics to be replaced by Engineering Science in Medicine later in 2017

We are improving our Nanoscience and Technology specialisation, a subject which is central to today’s great communication, digital and R&D revolution. We are introducing new elements into our Energy Science and Technology specialisation, a subject which is critical to achieve a sustainable future. We are revamping our computational engineering science specialisation, so it can cover topics such as control, automation, programming skills and robotics. We are planning for other specialisations in the future, such as an Engineering Science in Medicine specialisation which cover subjects like multi-functional sensors and medical physics. This all this ties in with the Singapore Government’s RIE 2020 plan: “The government will be sustaining its commitment to research, innovation and enterprise, and will invest $19 billion for the RIE2020 Plan over 2016 to 2020.........To maximise impact, funding will be prioritised in four strategic technology domains where Singapore has competitive advantages and/or important national needs. These are:

- Advanced Manufacturing and Engineering (AME)
- Health and Biomedical Sciences (HBMS)
- Urban Solutions and Sustainability (USS)
- Services and Digital Economy (SDE)

See more at: https://www.nrf.gov.sg/rie2020#sthash.soLgyJHh.dpuf

Looking ahead, there will be 8 modules (UEMs) where the student will be free to choose, and will have the opportunity of doing a double specialisation or going into a specialisation in much more in depth. There will also be hands-on projects in each of these specialisations.
International Accreditation

Our programme has officially received the news that it will be accredited for the next 5 years. The Evaluation Team of the Engineering Accreditation Board (EAB) of the Institution of Engineers, Singapore (IES) conducted a 2-day accreditation on-site visit to assess the Bachelor of Engineering (Engineering Science) program on 18th and 19th October 2016 against the criteria set out in the EAB Accreditation Manual. The result, ESP has passed with flying colours. The EAB summarised their report as follows.

Main strengths:
1) The mission and programme educational objectives of the Engineering Science program are periodically reviewed based on discussions with ESP’s Industry Advisory Committee.
2) In addition to the above, the SLOs and MLOs are periodically reviewed for improvement.
3) Staff and ESP Associates show great enthusiasm and passion for teaching and conducting hands-on experiments.
4) The student intake profile is good – attracting many good students primarily from both the Junior Colleges and overseas with equivalent qualifications.
5) The academic qualifications of the ESP associates are of high standard and their resources are supplemented by postgraduate students from their respective departments.
6) Teaching quality assurance is achieved via student feedback and a detailed review of teaching and examination results at the end of each semester.

Area for Improvement - We recommend the cross-disciplinary aspect of the program be more clearly articulated to the students.
International Exchange/Internship opportunities for ESP students

Many leading universities around the world have Engineering Science degree programmes or related programmes in subjects like Engineering Physics. The International Engineering Science Consortium (IESC) was established in 2013 and has 6 members:

Applied Science and Technology Graduate Group, College of Engineering, University of California, Berkeley, USA;

Division of Engineering Science, Faculty of Applied Science and Engineering, University of Toronto, Canada;

Engineering Science Programme, Faculty of Engineering, National University of Singapore, Singapore;

Graduate School of Engineering Science/School of Engineering Science, Osaka University, Japan;

School of Engineering Sciences, Royal Institute of Technology, Sweden

The faculty of Engineering Science at University of College London, UK

These are our partner universities and we have special student exchange agreements with them, so there is no problem in finding student exchange places for NUS ESP students. In addition, we able to send students on international internships. For instance, the University of British Columbia (UBC), the Okanagan campus, is providing Summer Internships for 4 of our students this year, giving free accommodation and food vouchers.

The International Engineering Science Consortium website is: http://www.engineering-science.org/.
The Consortium defines Engineering Science as follows: An interdisciplinary field bridging the gap between scientific theory and engineering applications with emphasis on the integration of mathematical, scientific, engineering and arts principles. In May 2015, ESP NUS hosted the first International Engineering Science Consortium Symposium. This inaugural symposium of IESC provided a platform for faculty members and students from the Engineering Science Consortium to share their thoughts/ideas on various engineering science problems and solutions with one another. The symposium featured some keynote lectures from top engineer scientists that inspire the engineering science community.

The next IESC Symposium will take place in 20th-21st June 2017 hosted by KTH in Stockholm. NUS ESP is financing two of our students to attend that conference.
Engineering Science around the world

Engineering Science degree programmes around have emerged in different ways. At NUS, it was a flagship programme jointly created by the faculties of Engineering and Science, while in some places in the world it grew out of physics departments, such as the Engineering Physics programmes at the Universities of British Columbia, Stanford and Princeton. In other places, it grew out of Engineering departments, such as the Department of Engineering Science at Oxford University or Division Of Engineering Science at Toronto University while elsewhere, it is an umbrella subject that encompasses applied sciences with engineering disciplines, as in the Royal Institute of Technology (KTH) Sweden and University College London (UCL). In all cases, it is described as an interdisciplinary subject for the future, a subject at the forefront of technology, required for the newer high tech industries, such as those in alternative energy technologies (e.g. solar cells), in medical, communications and semiconductor industries.

The following selected text from the websites of a few Engineering Science programmes around the world illustrates this common theme.
Engineering Science at University of Toronto:
http://engsci.utoronto.ca/explore_our_program/about_engsci/

Engineering Science at the University of Toronto is one of the most selective and advanced engineering programs offered in the world. Engineering Science at U of T is an enriched program that provides students with excellent preparation in a wide range of fields. Top students from across Canada and around the world choose to study in this program, making for a superb peer group that contributes significantly to the quality of the program and the student experience. On the order of two-thirds of the program’s graduates pursue postgraduate studies at top graduate schools around the world and, because of the rigor of their undergraduate experience, they generally perform very well. Graduates of the program are also well qualified to immediately embark on professional engineering-related careers. Engineering Science is separate from the other Engineering programs at the University of Toronto. The Engineering Science program has a unique “2+2” curriculum structure, namely a 2-year foundation curriculum followed by a 2-year specialisation curriculum. In the first two years, students develop a strong foundation in both engineering and science. Students then select one of eight Majors (Aerospace, Biomedical Systems, Electrical & Computer, Energy Systems, Infrastructure, Mathematics, Statistics & Finance, Nanoengineering, Physics or Robotics) to focus on in their final two years. Other key distinguishing program features of note are: The Engineering Science program is designed and delivered at a level that is more academically demanding; The Engineering Science program contains more mathematics, science and engineering science, with greater focus on deriving results using a first principles approach.
Engineering Science at Berkeley:  
[http://engineering.berkeley.edu/academics/undergraduateprograms/engineering-science](http://engineering.berkeley.edu/academics/undergraduateprograms/engineering-science)

You’re interested in engineering methods, but you love the sciences. You’re really strong in math, biology and physics. You’re attracted to a major that’s both interdisciplinary and multi-departmental. If so, you’ve come to the right place. Our engineering science program prepares students for advanced study in engineering, science and mathematics. It’s a perfect choice for those who want to pursue careers in green tech, energy systems, solar engineering and a lot more........ Students and faculty explore the intersection of what is possible in energy engineering, engineering math and statistics, engineering physics and environmental engineering science.

Engineering Physics at Princeton University:  
[http://engineeringphysics.princeton.edu/](http://engineeringphysics.princeton.edu/)

Interdisciplinary areas in physical sciences in engineering such as energy, environment, materials, microelectronics and photonics promise to become increasingly relevant in the twenty-first century. The Program in Engineering Physics, which provides students with a fundamental knowledge of physics, together with problem-solving skills, and an understanding of engineering, is designed to address the needs of students seeking innovative careers in today’s technological age. In addition, it allows students to keep their options open between physical sciences and engineering.
Engineering Physics at Stanford University:
https://physics.stanford.edu/undergraduateprogram/bs-engineering-physics

Engineering Physics prepares students to apply physics to tackle 21st century engineering challenges, and to apply engineering to address 21st century questions in physics. Although Engineering Physics is a relatively new program at Stanford (it was introduced about a decade ago), it has a long history at a number of universities......An Engineering Physics degree prepares students to work in the private sector or in national laboratories at the very forefront of technology, or to pursue an advanced degree in engineering. An Engineering Physics degree also prepares students to pursue an advanced degree in physics; other engineering majors do not. Industries that need people with very strong scientific backgrounds recognize the Engineering Physics major and what it stands for....... A significant fraction (over half) of both Physics and Engineering Physics majors go on to pursue advanced degrees (Masters or PhD) in engineering or physics. Engineering Physics majors tend to work on forefront ideas in technology and science, in either industry or academia. Areas might include aerospace, biophysics, medical physics, renewable energy (photovoltaics, battery technology, fuel cells, ...), transportation, quantum information science, semiconductors, or materials development. Careers could also include systems engineering, teaching, medicine, law (especially intellectual property or patent law), science writing, history of science, philosophy of science, science policy, energy policy, government, or management in technical fields. The Physics and Engineering Physics majors are great preparation for almost any career, because they teach students how to analyse complex problems and they give students a strong quantitative background that can be applied in any technical field.

Here is a sampling of Engineering Physics programs in North America:
Princeton University
Harvard University (Engineering Physics is a 'track' within Engineering Sciences in the School of Engineering and Applied Sciences at Harvard.)
UC Berkeley (This is a program within Engineering Science.)
Colorado School of Mines (Engineering Physics is the only undergraduate degree offered by the Dept of Physics at CSM.)
Cornell University (This undergraduate program is within the School of Applied and Engineering Physics.)
University of
Toronto (Engineering Science)  U of Wisconsin  U of British Columbia  Case Western Reserve  Ohio State University  Stanford University