

CHEMISTRY AND BIOLOGICAL CHEMISTRY



SCHOOL OF PHYSICAL &
MATHEMATICAL SCIENCES

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NANYANG
TECHNOLOGICAL
UNIVERSITY
SINGAPORE

School of Physical and
Mathematical Sciences
College of Science

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MESSAGE FROM THE HEAD



The Division of Chemistry and Biological Chemistry is one of the most rapidly growing chemistry departments in the region. Over the past decade, we have grown from zero to a department with 41 faculty members, 24 support staff, about 300 PhD students and research staff, and over 1000 undergraduates.

In our direct BSc Honours programme, students receive rigorous training that qualifies them to be educators, professional chemists in the industry, or to enter graduate school in the chemical sciences. Our curriculum places special emphasis on problem-solving, laboratory training, and project work – allowing our graduates to build teamwork and communication skills that are valued throughout the job market. Undergraduates have the chance to participate in research projects, under one-to-one supervision by our professors, from year one of their studies through to the final year research project and also have the option to

experience a semester-long stint of industrial internship with leading local and international companies and research institutes. Students can also spend a semester or two studying abroad at various top institutions as part of our international exchange programme.

I hope that you find subsequent pages of this brochure informative and interesting. Come and enrol with us for your undergraduate studies to start a fascinating journey into the molecular world!

**ASSOCIATE PROFESSOR
LING XING YI**
Head, Division of Chemistry and Biological Chemistry

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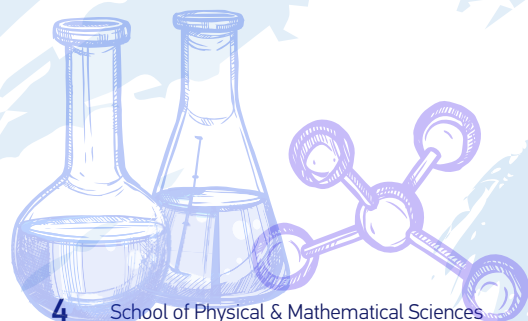


FOUR-YEAR DEGREE PROGRAMMES



BACHELOR OF SCIENCE (HONOURS) IN CHEMISTRY AND BIOLOGICAL CHEMISTRY

- World-class curriculum emphasising broad exposure to multiple chemistry disciplines, based on guidelines from the American Chemical Society.
- Top-notch undergraduate laboratory training with hands-on access to state-of-the-art equipment.
- Final-year students can choose between a Final-Year Project or a Professional Internship.
- Opportunities for international exchange with partner universities all over the world.



Scan to find out more about all programmes!



BACHELOR OF SCIENCE (HONOURS) IN CHEMISTRY AND BIOLOGICAL CHEMISTRY WITH SECOND MAJOR IN FOOD SCIENCE AND TECHNOLOGY



- Highly selective interdisciplinary programme offered in partnership with Wageningen University (The Netherlands), the School of Biological Sciences (SBS), and the School of Chemical and Biomedical Engineering (SCBE).
- Students gain an understanding of processes in the food industry from the perspectives of chemistry, physics, biology, engineering, and industry.
- Some courses are taught by professors from Wageningen University, one of the world's top centres of expertise in Food Science. Wide range of electives available from SPMS, SBS and SCBE.

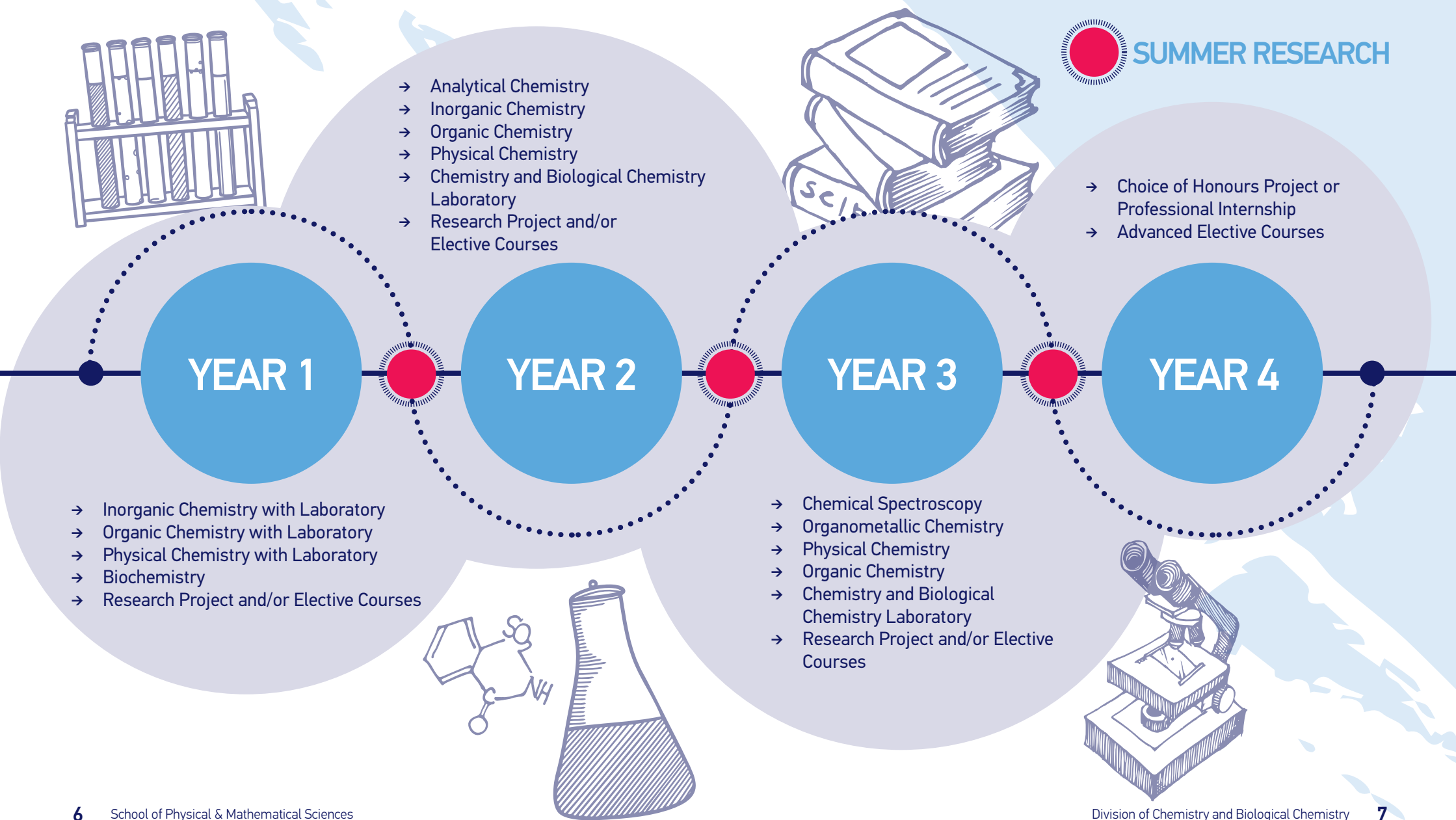
BSc (HONS) IN CHEMISTRY AND BIOLOGICAL CHEMISTRY WITH SECOND MAJOR IN ENVIRONMENTAL SCIENCE

- Highly selective interdisciplinary programme offered in partnership with the Asian School of Environment (ASE) and the School of Civil and Environmental Engineering (SCEE).
- Designed to train chemistry majors in the principles of environmental science and environmental resource management.
- Graduates are well-placed for employment in environmental consultancies, regulatory agencies, and the chemical industry.
- Some courses are offered by ASE and SCEE, covering areas such as Climate Change, Environmental Sustainability, Biogeochemistry, Air Quality Management and many more.



CURRICULUM OVERVIEW

BSC (HONS) IN CHEMISTRY AND BIOLOGICAL CHEMISTRY



ELECTIVES



ELECTIVE COURSES

- Advanced Analytical Chemistry
- Nanoscience and Nanotechnology
- Medicinal Chemistry
- Biomedical Imaging and Sensing
- Quantum Chemistry, Statistical Thermodynamics & Molecular Modelling
- Drug Design and Synthesis
- Analytical & Manufacturing Techniques in Pharmaceutical Industry

and many more

GENERAL EDUCATION REQUIREMENT (GER) COURSES

- Introduction to Computational Thinking
- Sustainability: Seeing Through the Haze
- Forensic Science
- Enterprise & Innovation
- Introduction to Data Science and Artificial Intelligence

and many more

Additional Courses for Second Major in Food Science and Technology

- Food Microbiology
- Food Chemistry
- Food Physics
- Food Process Engineering

Choice of Elective Courses, including:

- Biomedical Nanotechnology
- Pharmacokinetics and Biopharmaceutics
- Food Analysis and Safety

Additional Courses for Second Major in Environmental Science

- Environment and Society
- Natural Hazards, Climate Change and Society
- Climate Change
- Environmental Sustainability

Choice of Elective Courses, including:

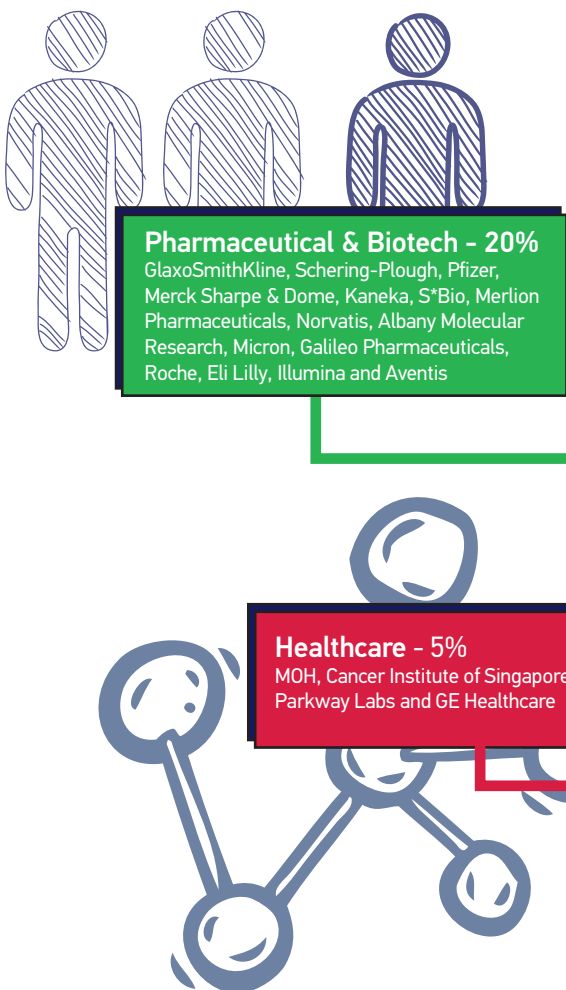
- Biogeochemistry
- Environmental Quality, Health and Safety Management
- Environmental Impact Assessment



CAREER PROSPECTS

Chemistry graduates find ready employment in a wide range of chemical-related industries, both in Singapore and overseas.

* Source: NTU Graduate Employment Survey



Government Agencies - 15%

Health Sciences Authority (HSA), DSO National Laboratories, Defence Science and Technology Agency (DSTA), National Environment Agency (NEA), and Intellectual Property Office of Singapore (IPOs)

Pharmaceutical & Biotech - 20%

GlaxoSmithKline, Schering-Plough, Pfizer, Merck Sharpe & Dome, Kaneka, S*Bio, Merlion Pharmaceuticals, Novartis, Albany Molecular Research, Micron, Galileo Pharmaceuticals, Roche, Eli Lilly, Illumina and Aventis

Healthcare - 5%

MOH, Cancer Institute of Singapore, SGH, Parkway Labs and GE Healthcare

Finance and Banking - 10%

Credit Suisse AG, DBS, OCBC and Maybank

Research Institutes - 16%

Institute of Chemical Engineering and Sciences (ICES), Institute of Bioengineering and Nanotechnology (IBN), Institute of Materials Research and Engineering (IMRE), and Institute of Microelectronics (IME)

Other Sectors:

Food Technology and Fragrance Industry

Asia Pacific Breweries, Fraser & Neave, Firmenich, Symrise and Givaudan

Other Sectors:

Petrochemical Companies

Shell, ExxonMobil, Sumitomo chemicals, Evonik, Solvay and Mitsui Chemicals

Other Sectors

Our graduates have gone into patent law, bioinformatics, and other intellectual property related jobs.

Scan to find out more about our career prospects!



PROFESSIONAL INTERNSHIPS

Our undergraduate programmes emphasise the importance of practical training. Students are provided with opportunities to undergo a professional internship, varying from 10 to 22 weeks, during their course of study. This internship can be conducted at a private or public organisation, either locally or overseas.

Our students have interned at numerous companies, institutes and R&D centers such as:

- Abbott Nutrition Research and Development
- Akzo Nobel Paints (Singapore)
- Asia Pacific Breweries (S)
- Genome Institute of Singapore
- Givaudan Singapore
- GlaxoSmithKline (GSK)
- Health Sciences Authority (HSA)
- Institute of Materials Research & Engineering (IMRE)
- International Flavors & Fragrances (Greater Asia)
- Nestlé
- Novartis Singapore
- Public Utilities Board (PUB)
- Robert Bosch (SEA)
- Roche Singapore
- Shimadzu (Asia Pacific)
- Symrise Asia Pacific (Flavors and Scent & Care)



My industrial attachment experience helped me immensely in seeking employment. The skills I picked up during my undergraduate research experiences, and the knowledge I acquired throughout the Chemistry and Biological Chemistry (CBC) programme played a role. While I was still interning at GlaxoSmithKline (GSK), I managed to secure employment during my final semester via GSK's Future Leaders' Programme.

The attachment gave me a channel to explore and apply the skills I picked up as a CBC undergraduate, in the context of the pharmaceutical industry. The experience helped me to settle into my job quickly. I recommend juniors who are considering a career in chemistry to take chemistry in NTU.

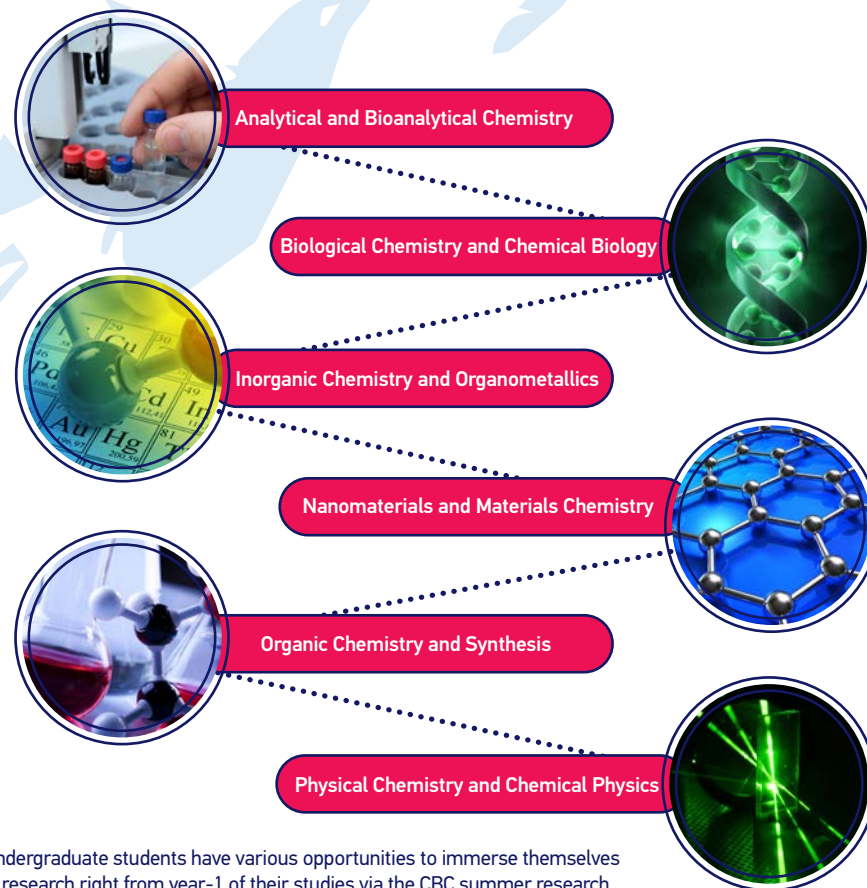
LIM JIE SHENG
Chemist Associate,
Technical Development Global Manufacturing
& Supply GlaxoSmithKline (GSK)
BSc (Hons) in Chemistry & Biological Chemistry



Scan to find out more about our internship programmes!

RESEARCH OPPORTUNITIES

Research within the Division covers a wide spectrum of fields in the realm of Chemical Sciences. We are particularly strong in the following areas with many of our faculty recognised internationally as leaders in their respective areas.



Undergraduate students have various opportunities to immerse themselves in research right from year-1 of their studies via the CBC summer research programme, URECA and Final-Year Projects. Students interested in research also have opportunities to pursue a PhD programme in NTU upon graduation with full scholarship support.

Research

Summer Research

Final Year Project

URECA



ALUMNI AND STUDENT TESTIMONIALS



I feel very grateful to have had an opportunity to be part of a young and energetic department like CBC and to have had wonderful supervisors and mentors during my time there. I greatly appreciate the opportunities that were given to me which allowed me to expand my knowledge and build confidence in my abilities. The valuable skills I've learned have given me a solid foundation upon which to build my career.

NUR FILZA BINTE MOHAMED ASLAM
Medical Science Liaison,
Perspectum Diagnostics (Singapore)
BSc (Hons) in Chemistry & Biological Chemistry,
Class of 2009
PhD in Chemistry & Biological Chemistry,
Class of 2017



Science is more than just understanding the theoretical and technical concepts. It encompasses creative thinking, logical and analytical reasoning, and sensitivity to details. These skills have been very useful to me even when I later decided to pursue a career outside of the chemicals industry.

CHERYL ONG
Governance & Strategy Manager,
Business Governance Markets, Australia and
New Zealand Banking Group Ltd
BSc in Chemistry & Biological Chemistry, Class of
2016

I strongly believe there is a direct correlation between the environment you're in and the person you become; all of the academics in SPMS were passionate about science, which created an ideal environment for the growth of my interest and led me to pursue my post-graduate studies in SPMS.



SIVARAJAN S/O KASINATHAN
Senior Process Development Scientist,
Process Development, Pfizer Asia Pacific Pte Ltd
BSc (Hons) in Chemistry & Biological Chemistry,
Class of 2013

I chose to spend more time in the research laboratories, which built a strong foundation to pursue postgraduate research with a relevant skill set. The most enjoyable part of the SPMS experience was the interspersed work-and-play attitude for both the staff and students. Classes and lectures became more personal and there was a strong social support network because of various activities held in the SPMS community.



TAY WEE SHAN
PhD student,
School of Physical and Mathematical Sciences
Nanyang Technological University
BSc (Hons) in Chemistry & Biological Chemistry,
Class of 2016

OVERSEAS EXPERIENCE



NORTH AMERICA

EUROPE

ASIA

EUROPE

- Imperial College, UK
- KTH Royal Institute of Technology, Sweden
- Norwegian University of Science & Technology, Norway
- Stockholm University, Sweden
- University College London, UK
- University of Edinburgh, UK
- University of Southern Denmark, Denmark
- University of Sussex, UK
- University of Warwick, UK
- University of York, UK

ASIA

- Hong Kong University of Science & Technology, Hong Kong
- Korea University, South Korea
- Pohang University of Science & Technology (POSTECH), South Korea
- Pusan National University, South Korea

NORTH AMERICA

- University of Waterloo
- University of Ottawa
- University of Western Ontario



Scan to find out more about our overseas exchange!



I did my Final-Year Project (FYP) at the Institute Curie in Paris, France. It was a fantastic experience! I was able to expand my knowledge on synthetic chemistry and also gain hands-on experience in various purification and analytical equipment while not forgetting to travel around and enjoy the beautiful places in France.

DERRICK TAN JING YANG

PhD student,
School of Physical and Mathematical Sciences
Nanyang Technological University
BSc (Hons) in Chemistry & Biological Chemistry, Class of 2016

One of the best decisions I have made during my undergraduate years in CBC was to do my Final-Year Project (FYP) overseas at University of Bath, UK. Not only did I forge new friendships with my overseas supervisor and lab group, I also had ample time for travel and leisure.



LEONG SHI XUAN

PhD student,
School of Physical and Mathematical Sciences
Nanyang Technological University
BSc (Hons) in Chemistry & Biological Chemistry, Class of 2018

GEM Explorer



GEM Discoverer



Scan to find out more about our Global Education Mobility (GEM) initiatives!

SCHOLARSHIPS

THE NANYANG SCHOLARSHIP

Awarded to students who excel academically, with strong leadership potential and outstanding CCA track records.

- Full coverage of subsidised tuition fees (after Tuition Grant).
- Living allowance of S\$6,500 per academic year.
- Accommodation allowance of up to S\$2,000 per academic year. (Applicable to scholarship holders who reside in NTU hostels only.)
- Travel grant of S\$5,000 for an overseas programme (one-off).
- Computer allowance of S\$1,750 (one-off).
- Priority for Overseas Programme.
- Participation in Scholars Orientation Programme, Scholars Award Ceremony, Outreach Programmes, and Eminent Speaker Series.
- No bond is attached to the Nanyang Scholarship apart from the three-year bond applicable to all Singapore PRs and international students under the MOE Tuition Grant Scheme.

THE COLLEGE OF SCIENCE SCHOLARSHIP

Awarded to students with a record of good academic performance.

- Full coverage of subsidised tuition fees (after Tuition Grant).
- Living allowance of S\$5,000 per academic year.
- No bond is attached to the College Scholarship apart from the three-year bond applicable to all Singapore PRs and international students under the MOE Tuition Grant Scheme.



For enquiries pertaining to financial assistance:

Tel: (65) 6790 4115

Email: FinAid@ntu.edu.sg



For enquiries pertaining to scholarships:

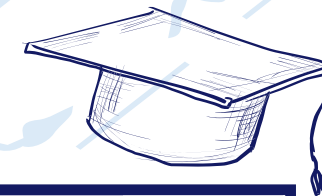
Tel: (65) 6790 6766

Email: ug_scholarships@ntu.edu.sg

Visit our Scholarships page for more details



ADMISSION REQUIREMENTS



Programme	GCE A-Levels	Polytechnic Diploma awarded in Singapore	International Baccalaureate Diploma	NUS High School Diploma	International & Other Qualifications
Chemistry & Biological Chemistry	Good H2 level passes in Chemistry and Mathematics or Physics	Good GPA in a relevant diploma	Chemistry and Mathematics/Physics at Higher Level	Major CAP of 2.0 in Chemistry and Mathematics/Physics	Chemistry and Mathematics/Physics at Senior High School Level/IB Higher Level
Chemistry & Biological Chemistry with 2nd major in Food Science and Technology					
Chemistry & Biological Chemistry with 2nd major in Environmental Sciences					

Office of Admissions
Student & Academic Services Department
Nanyang Technological University
Student Services Centre, #03-01
42 Nanyang Avenue, Singapore 639815

For local students

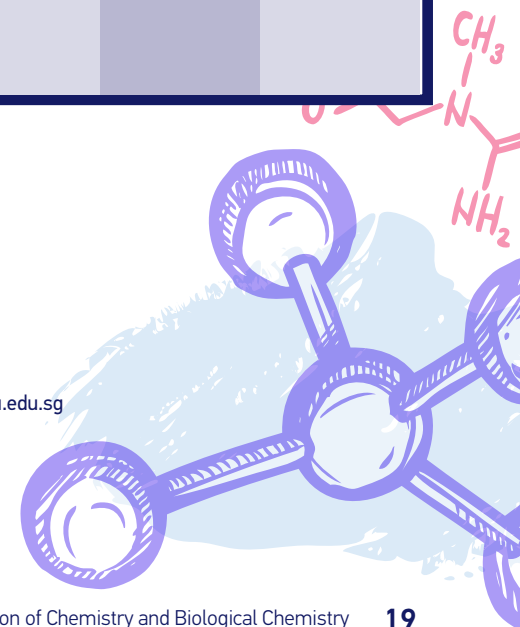
Tel: 6790 5055 / 6790 5972 • Email: adm_local@ntu.edu.sg

For international students

Tel: (65) 6790 5806 / (65) 6790 5807 • Email: adm_intnl@ntu.edu.sg



Visit our Admissions page for more details



MATHEMATICAL SCIENCES

$$f(x|\mu, \sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$
$$\zeta(s) = \frac{1}{\Gamma(s)} \int_0^\infty \frac{1}{e^x - 1} x^s \frac{dx}{x}$$
$$\hat{f}(\xi) = \int_{-\infty}^\infty f(x) e^{-2\pi i x \xi} dx$$
$$n \rightarrow \infty$$




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MESSAGE FROM THE HEAD



Founded in 2005, the Division of Mathematical Sciences (MAS) has come a long way, starting with five faculty members and an intake of 47 undergraduate students in August 2005. The graduate programme was established in 2006. Currently, MAS has 35 faculty members, around 50 graduate students, and over 1000 undergraduate students enrolled in several degree programmes: Mathematical Sciences, Mathematical Sciences with Minor in Finance, Mathematical Sciences & Economics (Double Major), Mathematical & Computer Sciences (Double Major), and Data Science & Artificial Intelligence.

Our faculty is highly active in research, and we have established a vibrant research culture that our undergraduates participate in and benefit from. We have a constant stream of academic visitors from all over the world, hosting workshops and conferences on a regular basis.

MAS is strongly committed to high-quality undergraduate education. The curriculum of our direct honours degree programme is designed with an emphasis on solid mathematical foundations, job relevance, and flexibility of course choice. Motivated and strong students can opt to take special advanced courses, and to participate in undergraduate research projects, supervised independent study courses, and overseas exchange programmes.

**Associate Professor
Chan Song Heng**
Head, Division of Mathematical Sciences

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FOUR-YEAR DEGREE PROGRAMMES

BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL SCIENCES

- Offers a good mix of fundamental, as well as applied, computational, and industrial aspects of Mathematics and Statistics.
- 18 months of foundational courses, followed by specialisation in one of four tracks: Pure Mathematics, Applied Mathematics, Statistics, or Business Analytics.

In partnership with Nanyang Business School (NBS)

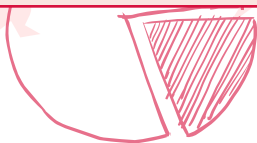
BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL SCIENCES WITH MINOR IN FINANCE

- Emphasises the use of mathematical methods in finance and economics. Building on the Mathematical Sciences curriculum, students take additional NBS courses in Banking and Finance.

In partnership with the School of Social Science (SSS)

BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL SCIENCES AND ECONOMICS (DOUBLE MAJOR)

- Intended for students interested in quantitative jobs in the financial services industry.
- Curriculum covers numerical, computational and statistical mathematical methods, as well as quantitative methods in economics. Graduates will have a strong interdisciplinary skillset, and a strong background in statistics and economics.



Scan to find out more about our programmes!



In partnership with the School of Computer Science and Engineering (SCSE)

BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL AND COMPUTER SCIENCES (DOUBLE MAJOR)

- Intended for students seeking careers in financial technology, cybersecurity, and data analytics, or postgraduate degrees in Mathematics, Computer Science, and related disciplines.
- Curriculum provides a strong foundation in core mathematical concepts, and in-depth training in one of four areas at the interface of Mathematical Sciences and Computer Science: Theoretical Computer Science, Cryptography and Cybersecurity, Financial Modelling, and Data Science.

BACHELOR OF SCIENCE (HONOURS) IN DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

- Intended for students interested in the rapidly expanding fields of data science and artificial intelligence (AI).
- Curriculum includes courses in both Mathematical Sciences and Computer Sciences, with an emphasis on the interactions between the two disciplines. Students read specialised courses in topics such as optimisation, regression analysis, high-dimensional statistics, data mining, machine learning, and cryptography.
- Participation in internship and industry-oriented research projects.

In partnership with the Division of Physics and Applied Physics (PAP)

BACHELOR OF SCIENCE (HONOURS) IN PHYSICS AND MATHEMATICAL SCIENCES (DOUBLE MAJOR) NEW

- Intended for students interested in research careers requiring strong computational and problem-solving skills or students pursuing postgraduate degree in Physics and Mathematical Sciences.
- Curriculum equips students an understanding of physical world through mathematical rigour and insights. It covers courses at the interface of Physics and Mathematics such as Differential Geometry and General Relativity, Algebraic Topology and Condensed Matter Physics, etc.

CURRICULUM OVERVIEW

$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx,$$

$$p_A(n) = \left(\prod_{a \in A} a^{-1} \right) \cdot \frac{n^{k-1}}{(k-1)!} + O(n^{k-2}).$$

$$\zeta(s) = \frac{1}{\Gamma(s)} \int_0^\infty \frac{1}{e^x - 1} x^s \frac{dx}{x}$$

BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL SCIENCES

APPLIED MATHEMATICS / PURE MATHEMATICS / STATISTICS TRACK

Year 1 + 2	Calculus Linear Algebra Discrete Mathematics Algorithms and Computing Probability and Statistics
Year 2 + 3	Specialisation Track and Electives Final Year Project or Professional Internship
Sample Courses for Pure Mathematics Track	Real and Complex Analysis Differential Geometry Number Theory Topology
Sample Courses for Applied Mathematics Track	Numerical Analysis Scientific Computing Optimisation Cryptography
Sample Courses for Statistics Track	Statistics Data Analysis Regression Analysis Time Series Analysis

BUSINESS ANALYTICS TRACK

Year 1 + 2	Business Operations & Processes Fundamentals of Management	Courses from NBS
Year 3 + 4	Final Year Project or Professional Internship Data Management Decision Tools for Managers Financial Analytics & Reporting Business Intelligence Principles of Economics Operations Research	

BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL SCIENCES WITH MINOR IN FINANCE

Offered in partnership with the Nanyang Business School (NBS)

In addition to the curriculum of Major in Mathematical Sciences, students read 15 Academic Units of banking and finance courses offered by NBS. The choice of courses includes:

- Business Finance
- Financial Modelling
- Derivative Securities
- Bank Risk Management

BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL SCIENCES AND ECONOMICS (DOUBLE MAJOR)

Offered in partnership with the School of Social Science (SSS)

Year 1	Microeconomics Macroeconomics	Courses from SSS
Year 2	Econometrics Mathematical Economics	
Year 3	Public Finance Industrial Organisation International Trade Game Theory and Applications to Social Sciences Financial Economics Cost/Benefit Analysis Econometric Modeling and Forecasting	

BACHELOR OF SCIENCE (HONOURS) IN MATHEMATICAL AND COMPUTER SCIENCES (DOUBLE MAJOR)

Offered in partnership with the School of Computer Science and Engineering (SCSE)

Year 1	Data Structures Algorithms	Courses from SCSE
Year 2	Object Oriented Design & Programming Software Engineering	
Year 3 + 4	Courses from Specialisation Track and Electives Final Year Project or Professional Internship	
Sample Courses for Theoretical Computer Science	Parallel Computing Advanced Topics in Algorithms	Courses from SCSE
Sample Courses for Cryptography and Cybersecurity	Cyber Physical System Security Digital Forensics	
Sample Courses for Data Science Track	Machine Learning Data Analytics and Mining	
Sample Courses for Financial Modelling Track	Advanced Data Management Neural Networks	

BACHELOR OF SCIENCE (HONOURS) IN DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

Offered in partnership with the School of Computer Science and Engineering (SCSE)

In this programme, students will explore the emerging field of data science and artificial intelligence, by mastering the synergistic disciplines of computer science and statistics.

Year 1	Data Structures Data Science	Courses from SCSE
Year 2	Object Oriented Design and Programming Human Computer Interaction Software Engineering	
Year 3	Artificial Intelligence Data Analytics and Mining	
Year 4	Cryptography and Network Security Data Science for Business	

Scan to find out more about all programmes!



BACHELOR OF SCIENCE (HONOURS) IN PHYSICS AND MATHEMATICAL SCIENCES (DOUBLE MAJOR)

NEW

Offered in partnership with the Division of Physics and Applied Physics (PAP)

Year 1+2	Optics, Vibrations and Waves Relativity and Quantum Physics Thermal Physics	Courses from PAP
Year 3	Quantum Mechanics Statistical Mechanics	
Year 4	Major Prescribed Elective courses + Final Year Project	

Scan to find out more about all programmes!

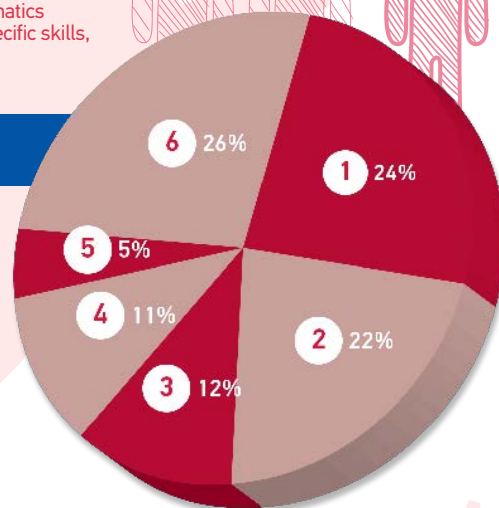


CAREER PROSPECTS

Due to the versatility provided by mathematical training, our graduates play a leading role in fields as diverse as finance, information technology, and biotechnology. Mathematics provides a superb foundation for developing job-specific skills, and is therefore valued by numerous employers.

INDUSTRY

- 1 Public Administration and Defence
- 2 Finance and Insurance
- 3 Information and Communication
- 4 Education and Research
- 5 Advertising Services and Market Research
- 6 Other Sectors



* Source: NTU Graduate Employment Survey

COMMON JOB TITLES

Public Administration and Defence

- Economist
- Policy Analyst
- Statistician

Information and Communication

- Applications Programmer
- Database Administrator
- IT Security Specialist
- IT Testing
- Software Engineer
- Systems Programmer

Education and Research

- Teacher
- Education Consultant
- Research Scientist

Finance and Insurance

- Actuary
- Financial Analyst
- Market Analyst
- Quantitative Analyst
- Risk Analyst
- Statistician

Other Sectors

- Health Services Manager
- Logistics Specialist
- Management Consultant
- Operations Research Analyst
- Resource Manager

COMPANIES THAT HIRE OUR GRADUATES

Public Administration and Defence

Central Provident Fund Board (CPF), The National Environment Agency (NEA), Defence Science and Technology Agency (DSTA), Ministry of Manpower (MOM), Inland Revenue Authority of Singapore

Finance and Insurance

KPMG, PriceWaterHouseCoopers LLP, DBS Bank, Flow Traders, Maybank

Information and Communication

Garena, Pulsemetrics, Nielsen, Facebook

Education and Research

Ministry of Education, Nanyang Technological University, National University of Singapore

Advertising, Services and Market Research

Kadence International, Dentsu Singapore, GroupM Asia Pacific

Other Sectors

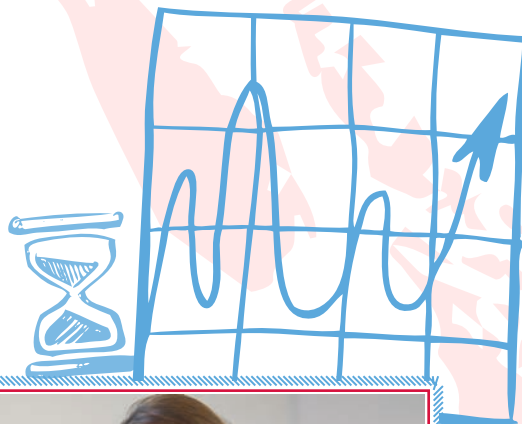
Procter & Gamble, Hewlett-Packard, Singapore General Hospital, FDM Singapore Consulting, Shopee Singapore, Micron Semiconductor Asia

PROFESSIONAL INTERNSHIPS

Our undergraduate programmes emphasise the importance of practical training. Students are given the opportunity to undergo a professional internship, varying from 10 to 22 weeks, during their course of study. This internship can be conducted at a private or public organisation, either locally or overseas.

Companies our undergraduates have interned at:

- Agilent Technologies Singapore
- A*STAR
- DSO National Laboratories
- Facebook
- Go-Jek Singapore
- Grab
- GroupM Singapore
- HP Inc
- Milliman
- OCBC Bank

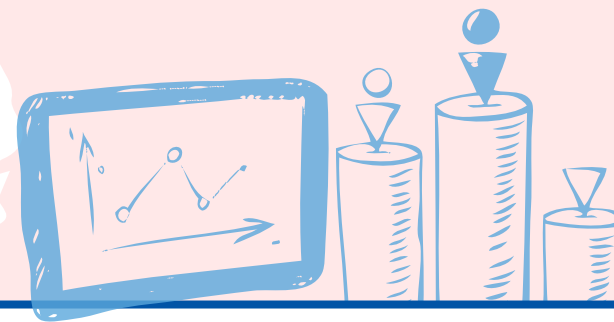


10%

35%

20%

Scan to find out more about our internship programmes!



In my final year as an Applied Mathematics undergraduate, I did a stint at Grab with the Data Science department. The programming courses in the SPMS curriculum positioned me well for the role. My supervisors at Grab were very friendly and offered their help whenever I needed guidance, making my time there a very enriching one. My work involved web scraping and data processing, and some of the skills I gained have proven useful in my subsequent role at a proprietary trading firm.

ELWIN SIM

Junior Trader at Flow Traders

BSc (Hons) in Mathematical Sciences, Class of 2018

In the vacation after my third year, I did an internship with Facebook, Singapore, doing account management and data analytics as part of the sales and marketing team. Being the only intern with science background did not demoralise me at all. I was happy that I was able to bring to the team in a unique set of skills. Studying mathematics allowed me to develop certain analytical and critical-thinking skills, and I was able to identify insights and pick out trends more quickly than my peers.

VALERIE EVANGELIN LAURENT

Account Manager at Facebook Singapore
BSc (Hons) in Mathematical Sciences
and Economics, Class of 2019



OUR FACULTY & THEIR RESEARCH

$$\mathcal{H}(x) = \mathbb{E}_x[\mathcal{I}(x)] = -\sum p(x) \log p(x)$$

$$\sum_{n \geq 0} p_k(n) x^n = x^k \cdot \prod_{i=1}^k \frac{1}{1-x^i}$$

$$q_A(n) = \left(\prod_{i \in A} a_i^{-1} \right) \cdot \frac{n^{k-1}}{(k-1)!} + O(n^{k-2})$$

$$\frac{\partial V}{\partial t} + \frac{1}{2} \sigma^2 \frac{\partial^2 V}{\partial S^2} + r \frac{\partial V}{\partial S} - rV = 0$$

$$\frac{1}{n} \sum_{i=1}^n \frac{1}{x_i} = \frac{1}{n} \sum_{i=1}^n \frac{1}{x_i}$$



**ASSOCIATE PROFESSOR
CHUA CHEK BENG**
Research Area: Optimisation

The history of mathematical optimisation dates to ancient Greece, when mathematicians such as Euclid and Heron solved optimisation problems in geometry. Since then, it has developed into a major field of mathematics, with numerous applications such as design of complex electronic circuits, the imaging of biological samples, computer-aided selection of financial portfolios, and more. My research focuses on the design and analysis of algorithms for solving optimisation problems, and improving our theoretical understanding of optimisation problems.

When you connect your laptop or phone to a WiFi access point, part of the data is corrupted by the time it reaches the antennas! And when you post a picture on Facebook, it is stored on a computer that may experience disk failure, which is why Facebook used to store redundant copies on different computers. To cope with such scenarios, data must be protected by redundancy schemes, which arise from the mathematical field of coding theory. I work on devising such coding schemes, with the aim of providing reliability at low cost.



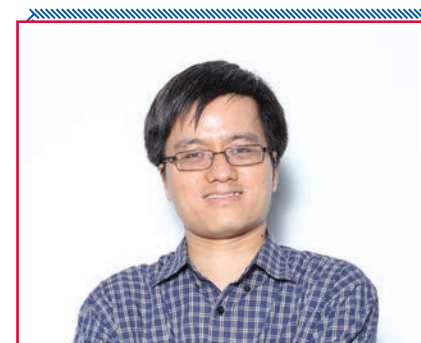
**ASSOCIATE PROFESSOR
FRÉDÉRIQUE OGGIER**
Research Area: Coding Theory



**ASSOCIATE PROFESSOR
CHAN SONG HENG**
Research Area: Number Theory

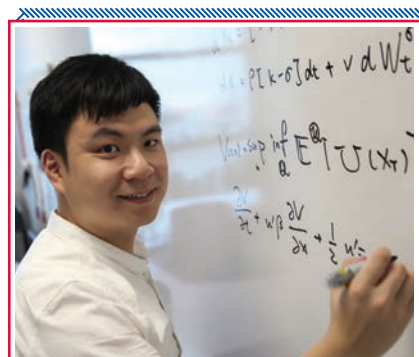
My research is related to the partition function, a function $p(n)$ that counts how many ways an integer n can be written as a sum of positive integers where ordering does not matter. For example, the partitions of 4 are given by $4 = 3+1 = 2+2 = 2+1+1 = 1+1+1+1$, so $p(4) = 5$. Mathematicians over the centuries have discovered surprisingly intricate features of the partition function. Ramanujan's discovery of three congruences, $p(5n+4) \equiv 0 \pmod{5}$, $p(7n+5) \equiv 0 \pmod{7}$, and $p(11n+6) \equiv 0 \pmod{11}$, inspired most of the research on the partition function in the past decades. Many mysteries remain unsolved, such as showing that asymptotically $p(n)$ is even and odd equally often.

Many pieces of everyday technology, from airplanes to tennis rackets, are made of composite materials, which contain many different components mixed together. Composites can be extremely durable and light, and can possess properties not found naturally. My research looks at how the properties of a composite material are affected by its constituents, a complicated topic where advanced mathematics plays an essential role. I use my expertise to design efficient algorithms that allow computers to solve the complex equations governing the physics of composite materials.



**ASSOCIATE PROFESSOR
HOANG VIET HA**
Research Area: Mathematical Analysis

In the era of big data, data can be produced and stored cheaply and on a massive scale. Scientific advances, as well as economic activities, are becoming more data-driven, bringing new opportunities and challenges for data analysis and statistics. My research aims to establish rigorous statistical frameworks for big data analyses, especially for economic and financial data. Mathematical analysis can provide rigorous guidance on many issues, such as the robustness of big data solutions.



ASSISTANT PROFESSOR PATRICK PUN
Research Area: Statistics & Mathematical Finance

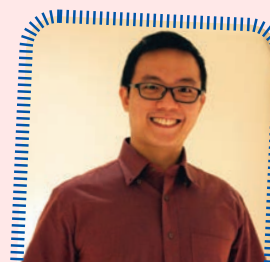
ALUMNI AND STUDENT TESTIMONIALS



BAI ZHONGZHENG
Data Scientist at First Derivatives
BSc (Hons) in Mathematical Sciences and Economics, Class of 2017

During my studies, I embarked on a research project studying a socio-economic model of how competition affects cooperation. The project was definitely challenging. Besides devouring countless research papers, I had to programme a computer experiment for participants. The skills I picked up during the project were transferable to non-academic contexts. I am now a part-time quantitative analyst at a FinTech startup, where my research and programming skills are put to good use.

The faculty members are really approachable and open to new ideas. For my final year project, I acquired data from a social sciences project and wanted to analyse it with advanced statistical methods. Even though this was my personal initiative, a professor agreed to guide and supervise me. The project allowed me to experience the end-to-end process of research, and prepared me for my current job as a policy maker at the Ministry of Education.



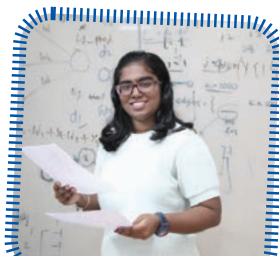
AARON CHIANG
Senior Assistant Director (Placement & Scholarships Policy),
Student Placement and Services Division, Ministry of Education
BSc (Hons) in Mathematical Sciences, Class of 2011



LI YONGMING
BSc (Hons) in Mathematical Sciences

The SPMS mathematics programme offers many learning opportunities outside the core curriculum. I had the opportunity to do a project involving natural language processing and text analytics. My advisor, Dr Fedor Duzhin, guided me through the process of reading the latest research papers, and how to learn independently about cutting-edge research.

Studying at SPMS is wonderful. The professors find interesting ways to help me understand concepts better and are always ready to answer questions. My courses are interesting, and enable me to challenge myself. I was also given the opportunity to participate in SPMS orientation camp, as part of the SPMS outreach committee. This has enabled me to really develop myself.



SELVARAJ BHARATHA
BSc (Hons) in Mathematical Sciences with Minor in Finance

Mathematics and economics are highly relevant to the world we are living in. During my time in SPMS, I "learned how to learn", and came to understand the importance of understanding and applying concepts, not just regurgitating answers. The foundational knowledge I acquired at SPMS brought me to where I am today, and will definitely be useful in ways I've yet to discover. I am and will always be proud to be an SPMS Alumna!



LUIZA LEE
Business Development, Institutional Sales Nomura Asset Management
BSc (Hons) in Mathematics and Economics, Class of 2014



SAMUEL TEO
Cryptologist at Centre for Strategic Infocomm Technologies (CSIT)
BSc(Hons) in Mathematical Sciences Cryptologist, Class of 2013

Studying mathematics, especially cryptography, prepared me for my current job as a cryptologist in CSIT (the Centre for Strategic Infocomm Technologies). Besides familiarity with theoretical issues in cryptography, I have the ability to solve problems analytically, and to pick up quantitative skills in multiple domains. Having gone through a rigorous curriculum, I am more resilient and better equipped to face challenges.



LI ENLIN
Student in the Doctor of Medicine Programme at
Duke-NUS Medical School
BSc (Hons) in Mathematical Sciences, Class of 2014

Studying mathematics gave me a strong foundation in critical thinking, which has served well in understanding concepts from other disciplines. I also benefited from the freedom and opportunities in MAS and SPMS to explore beyond my comfort zone, including the accelerated curriculum programme and overseas exposure.

OVERSEAS EXPERIENCE



CANADA

USA

EUROPE

ASIA

UNITED STATES

- Georgia Institute of Technology
- Rice University
- Stony Brook University
- University of Miami

CANADA

- University of Calgary
- University of Waterloo
- University of Western Ontario

ASIA

- Dong-A University, South Korea
- Fudan University, China
- Hong Kong University of Science and Technology
- Pusan National University, South Korea
- Yonsei University, South Korea

EUROPE

- Linköping University, Sweden
- Lulea University of Technology, Sweden
- Lund University, Sweden
- Technical University of Munich (TUM), Germany
- University of Amsterdam, Netherlands
- University of Bath, UK
- University of Bristol, UK
- University of Exeter, UK
- University of Groningen, Netherlands
- University of Leeds, UK
- University of Strathclyde, UK
- University of Surrey, UK
- University of Zurich, Switzerland
- Uppsala University, Sweden



KENNETH OOI
Doctoral Student at School of Electrical and Electronic Engineering, NTU
BSc (Hons) in Mathematical Sciences with Minor in Finance
Class of 2019

I did my **final year project overseas** in France at Institut National des Sciences Appliquées de Toulouse. Professor Nicolas Privault, the lecturer for the financial mathematics course in NTU, kindly agreed to supervise me and helped me to secure a project with Professor Anthony Réveillac from INSA Toulouse. My project is concerned with principal-agent problems. Simply put, I am investigating how best a boss should pay a worker. It is exciting to see how these real-world problems can be formulated mathematically and subsequently solved for specific scenarios to yield useful results. I have also had the chance to learn French and immerse myself in the culture during my stint at INSA Toulouse. Doing my FYP overseas has truly broadened my horizons not just in mathematics, but also the world in general.



My experience in MAS has been amazing and wonderful. There are many overseas events sponsored for us undergraduate students, from mathematics competitions to overseas forums. Personally, I am most grateful for the opportunity to join the **Heidelberg Laureate Forum**, an annual event in Germany where young researchers are given the chance to interact with pre-eminent computer scientists and mathematicians. Not only did the school fully sponsor my whole trip there, the professors wrote me an amazing recommendation letter that allowed me to be selected. Of 1500 applicants, only 200 were selected, and fewer than 10 were undergrads. The laureates we met included Andrew Wiles, who proved Fermat's Last Theorem, Barbara Liskov, a computing pioneer who created one of the first high-level programming languages, and many others. It was really an inspiring trip.



LIM MIN
Associate at GIC Private Limited
BSc (Hons) in Mathematical Sciences, Class of 2017



TAN PIN LIN
Research Assistant at NUS
BSc (Hons) in Mathematical Sciences, Class of 2018

I chose mathematics because it is a subject that interests me. Here at MAS, I have numerous opportunities, one of which was the chance to participate in the **International Mathematics Competition for University Students (IMC)**, an annual mathematics competition held that year in Blagoevgrad, Bulgaria. It was a wonderful experience! I got to meet mathematics students from all over the world, all of whom were passionate about mathematics.

I also got to learn more about Bulgaria, its history and culture. There was an excursion to Melnik, a town in the mountains with many historical buildings. We also got to explore Blagoevgrad, and visited the local museum and farmers' market. On top of it all, I managed to win a first prize in the competition (2016)!

SCHOLARSHIPS

THE NANYANG SCHOLARSHIP

Awarded to students who excel academically, with strong leadership potential and outstanding CCA track records.

- Full coverage of subsidised tuition fees (after Tuition Grant).
- Living allowance of S\$6,500 per academic year.
- Accommodation allowance of up to S\$2,000 per academic year. (Applicable to scholarship holders who reside in NTU hostels only.)
- Travel grant of S\$5,000 for an overseas programme (one-off).
- Computer allowance of S\$1,750 (one-off).
- Priority for Overseas Programme.
- Participation in Scholars Orientation Programme, Scholars Award Ceremony, Outreach Programmes, and Eminent Speaker Series.
- No bond is attached to the Nanyang Scholarship apart from the three-year bond applicable to all Singapore PRs and international students under the MOE Tuition Grant Scheme.

THE COLLEGE OF SCIENCE SCHOLARSHIP

Awarded to students with a record of good academic performance.

- Full coverage of subsidised tuition fees (after Tuition Grant).
- Living allowance of S\$5,000 per academic year.
- No bond is attached to the College Scholarship apart from the three-year bond applicable to all Singapore PRs and international students under the MOE Tuition Grant Scheme.

ADMISSION REQUIREMENTS



Programme	GCE A-Levels	Polytechnic Diploma awarded in Singapore	International Baccalaureate Diploma	NUS High School Diploma	International & Other Qualifications
Mathematical Sciences	Good H2 level pass in Mathematics	Good GPA in a relevant diploma, and good grades in at least 2 Mathematics modules	Mathematics at Higher Level	Major CAP of 2.0 in Mathematics	Mathematics at Senior High School Level/ IB Higher Level
Mathematical Sciences with Minor in Finance					
Mathematical Sciences & Economics (Double Major)	Good H2 level pass in Mathematics, and good pass in General Paper or Knowledge & Inquiry	Good GPA in a relevant diploma, and good grades in at least 2 Mathematics modules	Mathematics at Higher Level	Major CAP of 2.0 in Mathematics	Mathematics at Senior High School Level/IB Higher Level
Data Science & Artificial Intelligence Mathematical & Computer Sciences (Double Major)					
H2 Level Pass in Mathematics + H2 Pass in Physics/Chemistry/Biology/Computing					
Physics and Mathematical Sciences (Double Major)					
Good H2/HL/A Level or equivalent pass in Mathematics and Physics					



For enquiries pertaining to financial assistance:

Tel: (65) 6790 4115

Email: FinAid@ntu.edu.sg



For enquiries pertaining to scholarships:

Tel: (65) 6790 6766

Email: ug_scholarships@ntu.edu.sg

Visit our Scholarships page for more details



Visit our Admissions page for more details

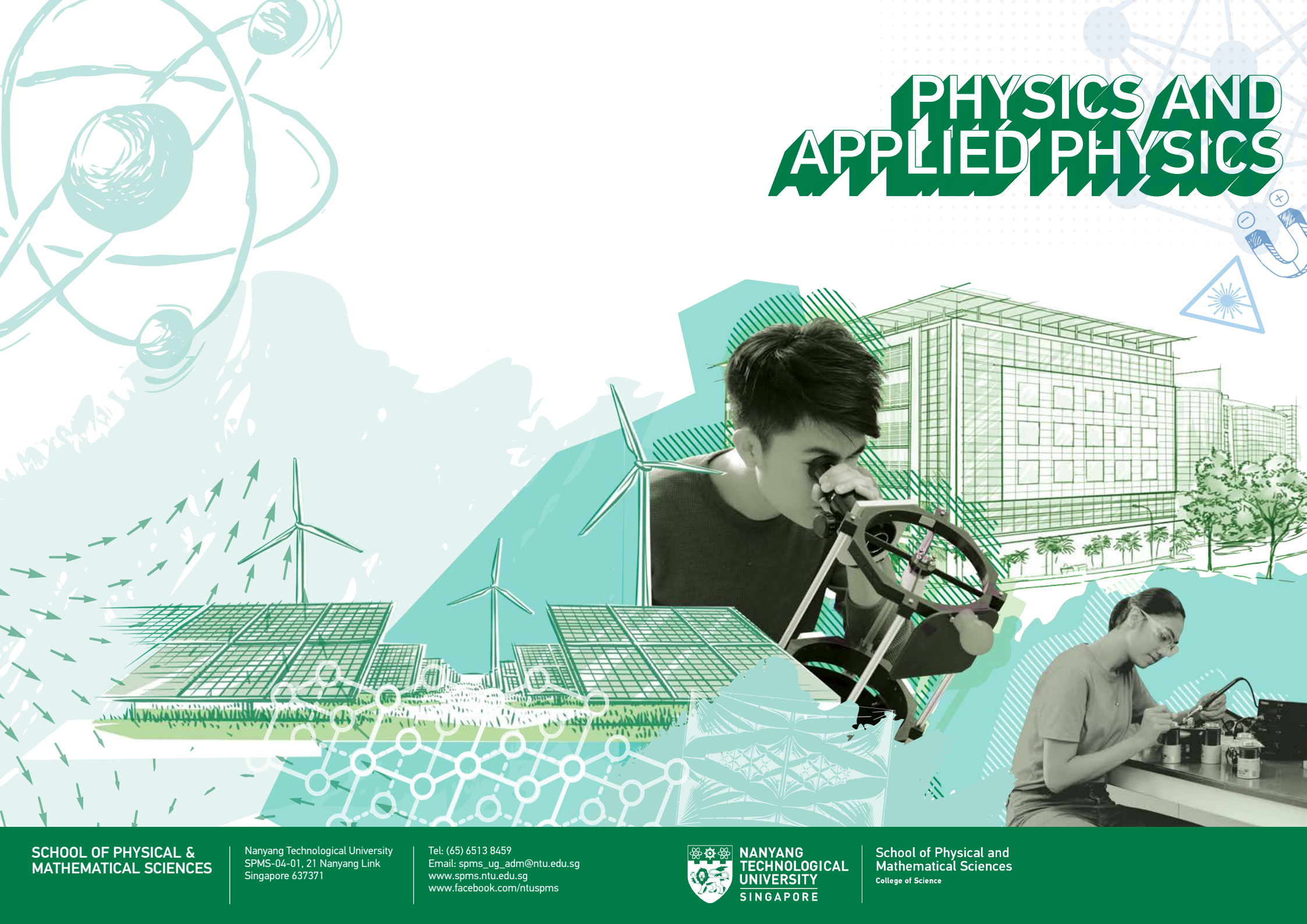


Office of Admissions
Student & Academic Services Department
Nanyang Technological University
Student Services Centre, #03-01
42 Nanyang Avenue, Singapore 639815

For local students
Tel: 6790 5055 / 6790 5972 • Email: adm_local@ntu.edu.sg

For international students
Tel: (65) 6790 5806 / (65) 6790 5807 • Email: adm_intnl@ntu.edu.sg

PHYSICS AND APPLIED PHYSICS



**SCHOOL OF PHYSICAL &
MATHEMATICAL SCIENCES**

Nanyang Technological University
SPMS-04-01, 21 Nanyang Link
Singapore 637371

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Email: spms_ug_adm@ntu.edu.sg
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www.facebook.com/ntuspm



**NANYANG
TECHNOLOGICAL
UNIVERSITY**
SINGAPORE

**School of Physical and
Mathematical Sciences**
College of Science

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MESSAGE FROM THE HEAD

Science and technology play a critical role in the modern economy, and nowadays the most important discoveries and inventions are often not confined to narrow technical specialisations, but draw upon multiple disciplines. Physicists are well-placed to navigate this complex landscape. They are trained in building theoretical models for complex systems, rigorously testing models against real-world data, and designing devices and methods to solve problems. This skill set is increasingly important in numerous technical domains.

In the Division of Physics and Applied Physics, we provide a top-notch physics-based education that imparts useful skills for a broad range of challenging and rewarding jobs. Our graduates have proven well-equipped for finding employment in industrial R&D, data science, computer security, finance, as well as education and academic research.

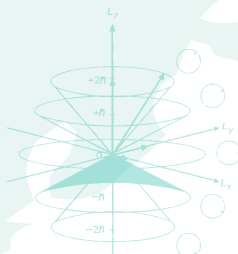
Our curriculum is designed to emphasise the most relevant topics in physics and applied physics, including both theoretical and

experimental aspects. We have a young and dynamic team of faculty members, dedicated to excellence in teaching and research. This includes NTU's first and only Principal Lecturer, known for his innovations in teaching. Our professors include world-class experts in quantum technology, nanotechnology, superconductivity, photonics, and other topics, who are all eager to share their cutting-edge knowledge. Aside from traditional coursework, our students are exposed to a great deal of cooperative learning and project work.

This brochure provides information about our programmes, as well as testimonials from current students and graduates. If you need more information, please visit our website, and do not hesitate to contact me or any of our other professors. We hope you will pursue your undergraduate education with us!

CHIA EE MIN ELBERT
ASSOCIATE PROFESSOR
Head, Division of Physics and Applied Physics

FOUR-YEAR DEGREE PROGRAMMES



BACHELOR OF SCIENCE (HONOURS) IN PHYSICS

Physics is the science of the natural world at the most fundamental and general levels. Physics students learn a wide variety of topics, including quantum technologies, statistical mechanics, computational physics, particle physics, photonics, and cosmology.

- Equips students with the analytical, computational, and experimental skills to perform research and development at the frontiers of scientific knowledge.
- Emphasis on fundamental topics in physics, such as statistical mechanics, quantum mechanics, condensed matter physics, particle physics, and computational physics.
- Optional course concentration in Nanotechnology

BACHELOR OF SCIENCE (HONOURS) IN APPLIED PHYSICS

Applied Physics is a discipline specialising in developing technological applications for the latest discoveries in physics. Applied Physics students learn about spintronics, nanotechnology, plasmonics, metamaterials, laser physics, and more.

- Equips students with the skills needed for technology development, based on translating cutting edge scientific discoveries into real-world applications.
- Emphasis on topics at the interface of fundamental science and applications, including nanotechnology, microfluidics, photonics, plasmonics, laser physics, and medical imaging.
- Optional course concentrations in Nanotechnology, Optical Technology, Semiconductor Technology, or Biophysics.

BACHELOR OF SCIENCE (HONOURS) IN PHYSICS AND MATHEMATICAL SCIENCES (DOUBLE MAJOR)

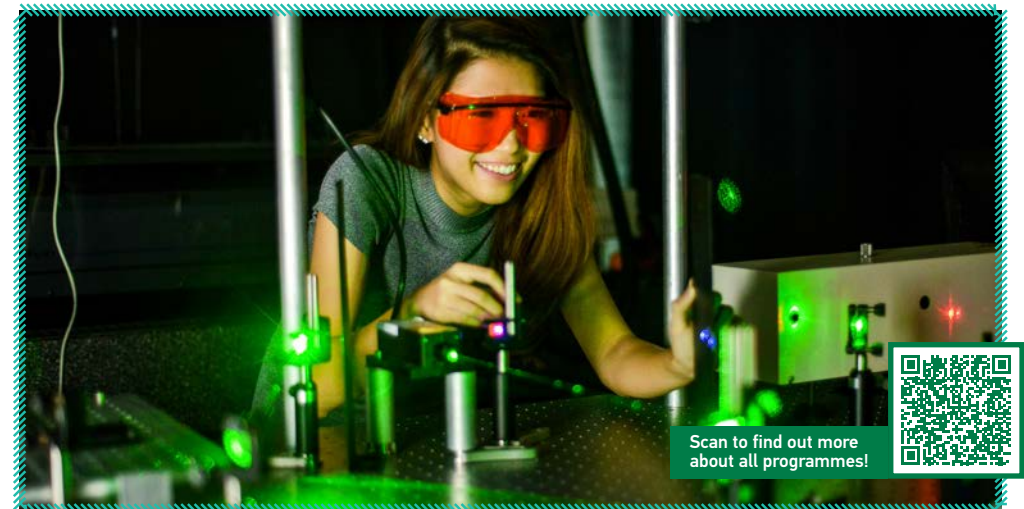
This selective Double Major programme is intended for students interested in careers requiring strong computational and problem-solving skills, or postgraduate degree in Physics, Mathematics, and related subjects.

- Selective and academically challenging programme providing rigorous and in-depth training in both physics and mathematics.
- Curriculum equips students an understanding of physical world through mathematical rigour and insights. It covers topics at the interface of physics and mathematics, such as differential geometry and general relativity, topology and condensed matter physics, quantum field theory, and more.

BACHELOR OF SCIENCE (HONOURS) IN APPLIED PHYSICS WITH SECOND MAJOR IN MICROELECTRONICS ENGINEERING

In this selective programme, Applied Physics students earn a Second Major in Microelectronics Engineering by taking courses such as circuit fabrication, microprocessor design, device simulation, and more.

- Selective and academically challenging programme at the frontier of Applied Physics and Electronics Engineering, providing students with a fundamental understanding of how microelectronic devices work, and how to design and implement them.
- Graduates are well-placed for careers in high-tech industries, particularly in the research and development of microelectronic devices.



Scan to find out more about all programmes!



CURRICULUM OVERVIEW



BSc (Hons) in Physics	
Year 1	Mechanics Optics, Vibrations and Waves Electricity and Magnetism Relativity and Quantum Physics Physics Laboratory
	Calculus Linear Algebra Programming in Python
Year 2	Quantum Mechanics Electromagnetism Thermal Physics Analytical Mechanics Physics Laboratory II
	Complex Methods Group Theory Probability and Introduction to Statistics Intermediate Mathematics Electives
Year 3 + 4	Statistical Mechanics <u>Physics Electives, including:</u> Atomic Physics Chaotic Dynamical Systems Classical and Quantum Information Computational Physics Condensed Matter Physics (*) Cosmology Econophysics Electrodynamics Fluid Mechanics Nanoscale Physics (*) Nuclear Physics Quantum Electronics Particle Physics Surface and Interface Physics (*)
	* For optional concentration in Nanotechnology

FOUNDATIONS OF PHYSICS AND MATHEMATICS

IN YEAR 1 & 2
For Double Majors In Physics And Mathematical Sciences:

Courses In Core And Major Prescribed Electives In Physics And Mathematics

ADVANCED TOPICS

IN YEAR 3 + 4
For Double Majors In Physics And Mathematical Sciences:

Courses In Core And Major Prescribed Electives In Physics, Mathematics, And In Common With Both Majors. Final Year Project Either In Mathematics Or Physics

BSc (Hons) in Applied Physics	
Year 1	Mechanics Optics, Vibrations and Waves Electricity and Magnetism Relativity and Quantum Physics Physics Laboratory
	Calculus Linear Algebra Programming in Python
Year 2	Quantum Mechanics Electromagnetism Thermal Physics Analytical Mechanics Physics Laboratory II Optics Introduction to Lasers (Elective)
	Complex Methods
Year 3 + 4	Physics Laboratory III <u>Applied Physics Electives, including:</u> Acoustics Biophysics (§) Biomedical Imaging and Sensing Classical and Quantum Information Computational Physics Condensed Matter Physics (*) (†) Fabrication of Micro- and Nano-electronics (‡) Medical Physics for Radiotherapy (§) Nanoscale Physics (*) (‡) Nuclear Physics Photonics (†) Plasmonics and Metamaterials Quantum Electronics (†) Semiconductor and Spintronic Devices (‡) Soft Condensed Matter Physics (§) Superconductors and Superfluids Surface and Interface Physics (*)
	* For optional concentration in Nanotechnology † For optional concentration in Optical Technology ‡ For optional concentration in Semiconductor Technology § For optional concentration in Biophysics or Medical Physics

FOUNDATIONS OF PHYSICS AND MATHEMATICS

IN YEAR 2
For Second Major in Microelectronics Engineering:

Circuit Analysis, Analogue And Digital Electronics

ADVANCED TOPICS

IN YEAR 3 + 4
For Second Major in Microelectronics Engineering:

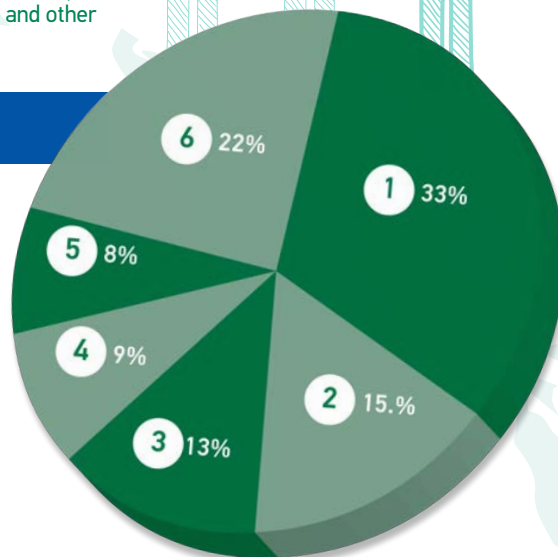
Microprocessors, Very-large-scale integration Systems, CMOS Process and Device Simulation.

CAREER PROSPECTS

Physics and Applied Physics graduates are employed in a wide range of occupations, including research and development (R&D) in industry and academia, education, finance, software development, and other professional positions.

INDUSTRY

- 1 Education and Research
- 2 Electrical and Electronics Products
- 3 Information and Communication
- 4 Public Administration and Defence
- 5 Finance and Insurance
- 6 Other Sectors



* Source: Graduate Employment Survey 2017

COMMON JOB TITLES

Education and Research

- Physicist
- Laboratory Manager
- Research Scientist
- Teacher

Electrical and Electronics Products

- Laboratory Executive
- Operations Manager
- Process Engineer
- Product Engineer
- Technical Support Engineer

Information and Communication

- Applications Programmer
- Data Scientist
- IT Security Specialist
- Software Engineer

Public Administration and Defence

- Armed Forces Personnel
- Defence Science Engineer
- Policy Analyst

Finance and Insurance

- Financial Analyst
- Financial Consultant
- Quantitative Analyst

PROFESSIONAL INTERNSHIPS

Our undergraduate programmes emphasise the importance of practical training. Students are given the opportunity to undergo a professional internship, varying from 10 to 22 weeks, during their course of study. This internship can be conducted at a private or public organisation, either locally or overseas.

Companies our undergraduates have interned at:

- Ace Pacific
- AEM Singapore
- Century Technology
- Ecoponics
- Environmental Solutions (Asia)
- Eurofins Mechem
- Ingenim
- Micron Semiconductor Asia
- Robert Bosch (SEA)
- Singapore Health Services (SingHealth)
- Singapore Institute of Manufacturing Technology
- Thermo Fisher Scientific



During my sophomore year, I visited the DSTA career booth at the SPMS job fair to learn more about the role that DSTA plays in harnessing technology for Singapore's defence. I secured the opportunity to intern at DSTA's Networked Systems Programme Centre from July to December 2015, where I took part in a project involving data and time series analysis. The rigorous theoretical physics and mathematics

courses offered by SPMS gave me a strong foundation for analytical and quantitative skills. I was able to understand the technical issues, and to derive insights from the data using Python and R, as well as specialised data analytics programmes such as RapidMiner, IBM SPSS Statistics and Tableau.

The internship built up my confidence and greatly broadened my skillset. In 2015, I attended a networking session hosted by NTU, and interacted with the hiring managers from DSTA. I secured an interview with the organisation before graduation, and am now an engineer at DSTA's C4I Development Programme Centre, where I develop sense-making capabilities for maritime security. I feel a sense of pride and achievement, knowing my skills can contribute to the defence and national security of Singapore.

YEOW JUN YI (PICTURED FAR LEFT)
Engineer
Defence Science and Technology Agency
BSc (Hons) in Applied Physics, Class of 2016



Scan to find out more about our internship programmes!

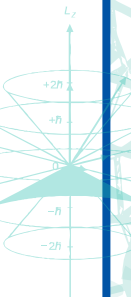
OUR FACULTY AND THEIR RESEARCH

$$i\hbar \frac{\partial \psi}{\partial t} = H\psi$$



GU MILE
ASSISTANT PROFESSOR
Quantum Information and Complexity Science

Quantum science and complexity science seem to be worlds apart. One deals with individual photons and atoms, while the other is associated with large-scale phenomena like weather systems and traffic networks. Yet recent developments reveal that the unique properties of quantum particles can help us understand the data in the environment around us. My research deals with the remarkable features of quantum information – entanglement, non-locality, and quantum superpositions – and their implications for our basic concepts of causality, reality and complexity. I also investigate how these fundamental theories can be used to design quantum protocols to model and simulate problems in the macroscopic world.



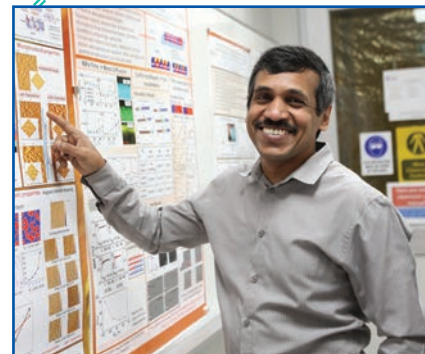
Photonics is the science of controlling and manipulating light. Its applications are wide-ranging, and include lighting, displays, solar panels, fibre-based internet communications, laser surgery, and even advanced manufacturing processes. My research involves devising nanometer-scale devices that alter how light interacts with matter. This line of research involves making use of cutting-edge nanofabrication technologies, newly-discovered materials that have exotic optical properties, as well as clever use of the laws of physics.

CESARE SOCI
ASSOCIATE PROFESSOR
Nanophotonics and Nanotechnology



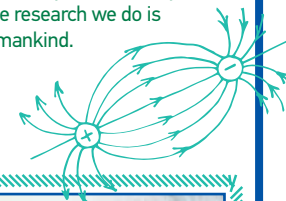
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \frac{\partial \mathbf{E}}{\partial t}$$



S. N. PIRAMANAYAGAM
ASSOCIATE PROFESSOR
Spintronic Devices

Devices such as smartphones and computers, which we use everyday, can store huge amounts of information in tiny volumes, such as SD cards. My research addresses the following questions: What are the limitations to storing information at high densities? What laws of physics can be exploited to make better memory storage devices? How can materials be tailored to push memory technologies further? My laboratory fabricates materials and nanostructures, using techniques such as sputtering and lithography, to serve as prototype memory storage devices. We work closely with industry partners to ensure that the research we do is practical and useful to humankind.



The hidden and intricate dance of electrons in materials lies at the heart of our daily interactions with the physical world. For example, electrons enable the bonding between atoms that gives solids their rigidity, and the quantum nature of electronic spin enables modern magnetic data storage technology. My research focuses on theoretically mapping out the possible paths of electrons as they traverse the complicated landscape of a material. I aim to use this fundamental understanding to design new quantum materials and quantum machines. Such "quantum engineering" involves re-imagining how electrons can move together, consistent with the laws of quantum mechanics.

JUSTIN SONG
ASSISTANT PROFESSOR
Quantum Condensed Matter Physics



Scan to find out more about
our faculty's research!

$$\Psi = \frac{1}{\sqrt{N}} \sum_p s(p) \psi_{p(1)} \cdots \psi_{p(N)}$$

$$A(k) = -i \langle \Psi_k | \nabla_k | \Psi_k \rangle$$

ALUMNI AND STUDENT TESTIMONIALS



CHUA CHERN FEI
Optics Engineer, Emage Vision Pte Ltd
BSc (Hons) In Applied Physics, Class of 2011

I work as an optics engineer in a local company that supplies custom machine vision solutions to end-customers. Most of my work involves designing optical systems for inspecting very specific products, for which there is simply no off-the-shelf solution.

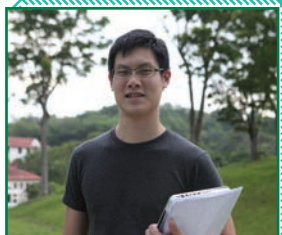
During my time as a Physics and Applied Physics student, apart from learning physics theories, there were plenty of practical opportunities: lab, research, projects, and more. These helped to develop my skills in troubleshooting, data analysis, and, most important of all, critical thinking. In my opinion, this kind of learning experience is particularly valuable in the modern world of multidisciplinary engineering.

SPMS is a very friendly place. The coursework is intellectually challenging, and the common areas are cosy and conducive for spending time in. The jovial chatter during term time, anxious exchanges during exam period, the peace and quiet during evenings – all this formed an unforgettable undergraduate life! I am personally grateful for the efficiency and flexibility of the professors, teaching assistants, and staff. I had the chance to teach in classes and laboratories, and to try out Making and Tinkering. I even managed to source for my own internship, and freely explore my research interests. If given the chance, I would like to be back in SPMS!



ERICO TJOA
Research Engineer, A*STAR
BSc (Hons) in Physics with Second Major in Mathematical Sciences, Class of 2018

Looking back after 4 years, I benefited from a curriculum structured with great foresight. The Division of Physics and Applied Physics recognised the growing importance of computing skills, and incorporated many programming modules into the curriculum. These skills are now my rice bowl as a PhD student working on numerical simulations. Many of my friends have secured positions in the corporate world, such as data analysts. SPMS was the most nurturing of environments. Professors are willing to mentor undergraduates, and the School's ties to external research institutes provide opportunities to experience research outside of academia. This is the best thing about SPMS – students have countless avenues to explore what interests them.



JEREMY LIM ZHEN JIE
PhD Candidate
SUTD Mathematics and Science Cluster
BSc (Hons) In Physics, Class of 2018



TAM QIAN XIN
Teaching Assistant at NTU
BSc (Hons) In Physics, Class of 2013

Why is hair attracted to combs? Why does metal feel colder than wood? How do pianos produce sound? These everyday phenomena have interested me since I was little, and led me to study Physics. During my undergraduate studies at NTU, these “why” questions have been replaced by “how”, but there are yet more “whys” as I go further in depth into various topics. I enjoyed the opportunities for hands-on training, including my Final Year Project where I did mechanical design, made my own induction coils, conducted experiments, etc. These experiences gave me the confidence to challenge unsolved problems, think out of the box, and be ready for the unexpected.

I enjoyed the opportunity to work on projects as early as freshman year. That allowed me to practise the discipline of Physics, experience the triumphs and pitfalls inherent to research, and appreciate how knowledge evolves. I also participated in the International Physicists' Tournament (IPT) in Switzerland, and had a wonderful time debating physics with other young scientists globally. Such opportunities for expanding your horizons were abundant, and gave me a very fruitful college experience.

My degree in physics gave me not only a strong mathematical foundation but, more crucially, taught me to think critically. These skills have proven very transferable and have been a major asset in my career as a cognitive and computational neuroscientist.



ANG YUEN SIANG
Postdoctoral Fellow, Harvard University
BSc (Hons) in Applied Physics, Class of 2013

I was very lucky to have spent 8 years (Undergrad + PhD) in PAP. For me, an SPMS Physics education was not only about picking up technical and technological skills, but also about being curious and developing passion for one's subject of study. I believe this shaped us to be creative, adaptive and nimble in picking up new skills and knowledge. These are lifelong lessons which impacted me positively beyond the classroom and in the workforce. I would also like to shout out to the friends and professors in SPMS, whose brilliance and determination I am thankful for and humbled by. It was my great fortune to have shared a path with them.



DARRELL TAY
Data Scientist, Agoda
BSc (Hons) in Physics, Class of 2012

OVERSEAS EXPERIENCE



CANADA
USA

EUROPE

ASIA

UNITED STATES

- Georgia Institute of Technology
- United States Military Academy

CANADA

- Lakehead University
- University of The Fraser Valley
- University of Toronto
- University of Waterloo

ASIA

- Ewha Womens University, South Korea
- Korea Advanced Institute of Science & Technology (Kaist)
- Seoul National University
- National Taiwan University
- The Chinese University of Hong Kong
- Yokohama National University, Japan

EUROPE

- Aalto University, Finland
- Ecole Polytechnique Federale De Lausanne, Switzerland
- Norwegian University of Science and Technology, Norway
- Tampere University of Technology, Finland
- University College London, UK
- University of Glasgow, UK
- University of Sheffield, UK
- University of Strathclyde, UK
- University of Surrey, UK
- Uppsala University, Sweden

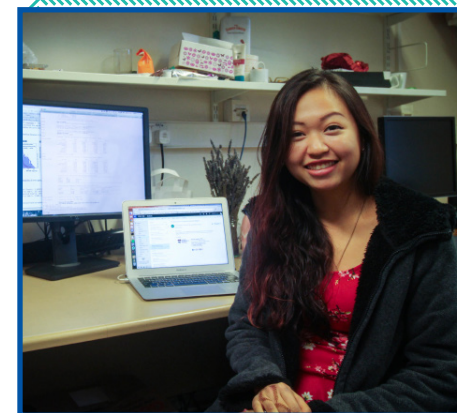


The most exciting experience I had at NTU was at the PLANCKS competition, which was held in Croatia. PLANCKS is a theoretical physics competition for undergraduate and master's students, and I am incredibly grateful to be given the opportunity to represent NTU. It was an eye-opening experience to interact with physics majors from different parts of the world, as well as to deepen my understanding of the subject. I am confident that my experiences and lessons I have learnt in NTU will help me in the future.

KHATEE ZATHUL ARIFA
BSc (Honours) in Physics

I had the opportunity to complete a semester abroad at the University of Toronto and to do an Overseas FYP at the High Energy Physics group in University College London. I learnt many valuable skills in and outside of Physics, and the experience also gave me a leg up in transitioning into my career as a Data Scientist in London.

QUEK CHAI SHAN
Data Scientist at Tessian
BSc (Hons) in Applied Physics, Class of 2018



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For enquiries pertaining to scholarships:

Tel: (65) 6790 6766

Email: ug_scholarships@ntu.edu.sg

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ADMISSION REQUIREMENTS



Programme	GCE A-Levels	Polytechnic Diploma awarded in Singapore	International Baccalaureate Diploma	NUS High School Diploma	International & Other Qualifications
Physics Applied	Good H2/HL/A Level or equivalent pass in Physics and Mathematics	Good GPA in a relevant diploma, and good grades in at least 2 Mathematics modules	Physics and Mathematics at Higher Level	Major CAP of 2.0 in Physics and Mathematics	Physics and Mathematics at Senior High School Level/IB Higher Level
Physics					
Physics & Mathematical Sciences (Double Major)					
Applied Physics with Second Major in Micro-Electronics Engineering					



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Nanyang Technological University

Student Services Centre, #03-01

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For international students

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