NUS National University of Singapore | College of Design and Engineering

CDE Forging New Frontiers

Issue 02 | Jul 2024

Welcome to the latest edition of the CDE Research Newsletter — Forging New Frontiers!

The theme of this issue is *From Idea to Reality*.

At the foundation of this issue is a series of breakthroughs at CDE that form the impetus of real-world technical impact and serve as catalysts towards societal and policy impact. Importantly, these innovations showcase the diversity of fields where our CDE community are driving change, from energy and sustainability to sensors and biomedicine.

Examples of our pioneering featured work include a study led by Associate Professor Jimmy Peng (Electrical and Computer Engineering) that proposes a framework for electric vehicle (EV) charging infrastructure to increase accessibility while helping policymakers in planning strategy.

Research by Associate Professor Zhao Dan (Chemical and Biomolecular Engineering) and his team has realised porous crystal technology for highly sensitive and specific gas sensing, which spans chemical detection through atmospheric monitoring.

Assistant Professor Clement Zheng (Industrial Design) embedded interactive circuits into ceramic, taking an everyday material to new heights. This opens doors to everything from touch-sensitive plates to smart flowerpots!

In healthcare, Assistant Professor Eliza Fong (Biomedical Engineering) led research to pioneer the development of a hydrogel capable of markedly prolonging the use of cancer cells for drug testing, which could change how we personalise patient treatment.

Taking a page from nature, Associate Professor Benjamin Tee (Materials Science and Engineering) and his team developed 'eAir,' a pressure sensor that provides vital feedback to doctors in scenarios such as surgical settings.

In a major step forward towards chip technologies for everything from smart buildings to wearables, Professor Massimo Alioto is serving as Director of the FD-fAbrICS (FD-SOI Always-on Intelligent & Connected Systems) joint lab, which is markedly enhancing the energy efficiency of chips that power AI devices.

In sum, this issue reveals a profoundly agile ecosystem at CDE that validates innovation and provides a clear path towards large-scale societal and policy impact. Our community is proud to be a cornerstone of bridging ideas with reality.

We hope you enjoy the issue!

Dean Ho
Editor-in-Chief

Supercharging the resilience of the EV ecosystem

Uncovering the impact of urban flooding on the accessibility of EV chargers paves the way for mitigation strategies that help policymakers strengthen the resilience of charging infrastructures.

Read more >

Sniffing out gases with precision

Flexible, shape-shifting organic frameworks are capable of sensing gases with high precision for applications in adsorption, separation and storage.

Read more >

Serving innovation on a ceramic platter

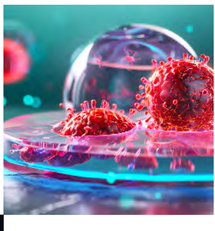
Innovative ceramic wares with built-in electronic circuits are capable of responding to touch, temperature and moisture, blending technology with everyday items to create convenience and connection.

Read more >

Keeping cancer cells content

A jelly-like hydrogel platform keeps tumours alive for ten days, enabling an effective testing ground for various anti-cancer drugs and treatments.

Read more >



Learning from the lotus leaf

Inspired by the lotus leaf, the 'eAir' sensor achieves near-ideal pressure sensing and is applicable in diverse liquid environments, including those involved in medical settings.

Read more >

Turbocharging the energy efficiency of AI processors

Breakthroughs in chip design techniques offer three crucial benefits for AI devices: reduced power consumption, extended battery life and the ability to support intense computational workloads.

Read more >

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Welcome to the first CDE Research Newsletter for 2025!

We are excited to kick off our first issue with a topic that will be a cornerstone of innovation for the NUS CDE community: Robotics!

The field of robotics is vast, and covers highly diverse topical domains that span artificial intelligence, built environment, mechanical engineering, biomedical engineering, electrical and computer engineering, design, and beyond. With regards to applications, everything from healthcare to drones, and construction to disaster relief are poised for major advances due to innovations in robotics.

Importantly, the continued implementation of new robotics technologies into everyday operations across industries will also have far-reaching impact in public policy and the social sciences.

Bridging ideation with real-world impact is a hallmark of NUS CDE, and we're excited to feature our colleagues' amazing work in robotics as we kick off another exciting year from our community. Enjoy!

Dean Ho
Editor-in-Chief

Teaching soft robots self-awareness

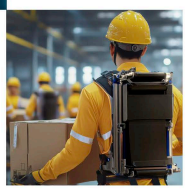
Soft robots with human-like perception can anticipate sensory inputs, detect contact and adapt dynamically, paving the way for applications in autonomous exploration and precision-driven medical procedures.

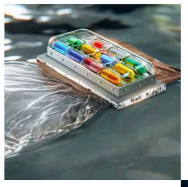
Read more >

A robust robotic support system

Driven by a differential series elastic actuator, a novel back-support exoskeleton aids users during lifting tasks, easing strain without adding muscle activation to the back and legs.

Read more >





Soft robots take on hard tasks

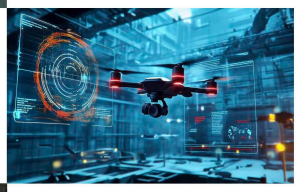
Soft, robust miniature robots powered by fluid kinetic energy can traverse tricky terrains at impressive speeds, offering a valuable new tool for search and rescue operations.

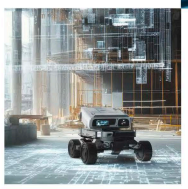
Read more >

Lean, mean flying machines

A fast-adaptive estimator for robust flight control draws from the best of both deep-learning techniques and conventional control algorithms to improve drone performance.

Read more >





Helping robots find their way around the construction maze

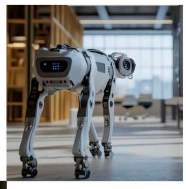
By improving how unmanned ground vehicles see and navigate complex, cluttered construction sites, automation is set to transform tasks like site mapping and monitoring.

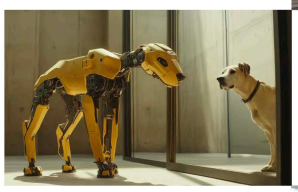
Read more >

Automating 3D scanning of built environments

By integrating building information with indoor spatial data, robots are equipped with the capability to navigate and map complex indoor spaces more efficiently, advancing how industries capture the digital representation of the built environment.

Read more >





Teaching robodogs new tricks

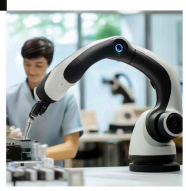
Modelled on the neural control systems of animals, a new layered control framework enables legged robots to navigate complex terrains with greater agility and precision.

Read more >

Robot safety a top priority

Designing safe, reliable and human-centric robots is a growing priority as they become an integral part of daily life.

Read more >



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National University Hospital

EnvisioningHealth

Changing Lives One Idea At A Time

Innovate to Elevate

As an academic medical centre, we leverage technology, enhance collaborations and embrace continuous learning to address the diverse health issues in our community.

The dawn of robotic tele-surgery

NUH clinician-scientists and Japanese experts are edging remote surgeries closer to reality, broadening access to specialised care in underserved regions.

Outsmarting operational challenges with artificial intelligence

From Pathfinder to CalSense to MiSSi, a suite of AI-driven tools gives NUH a shot in the arm, enhancing the hospital's patient care and operational efficiency.

Uncovering hidden heart diseases

Project Reset is a nationwide, first-of-its-kind study that aims to explore the hidden causes of heart disease, which will help unlock research discoveries and develop new strategies for early detection and prevention.

Sniffing out nose cancers

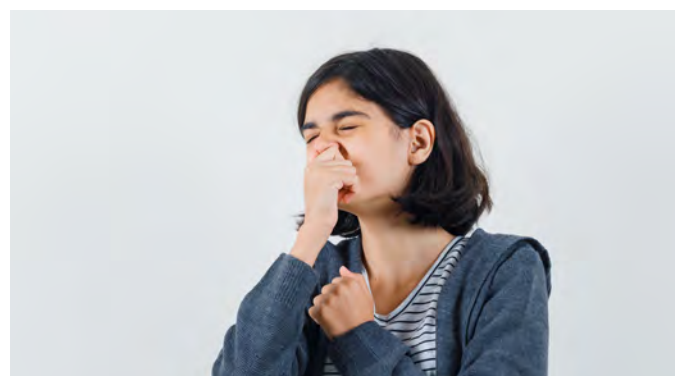
A large-scale screening research study aims to enhance the detection of early-stage nose cancer, which could significantly improve treatment success and survival rates.

If genes could talk: tailoring precision medicine for Singapore and beyond

A Singaporean pilot study on pharmacogenomics sharpens the focus of precision medicine, tailoring treatment efficacy for the region's diverse genetic landscape.

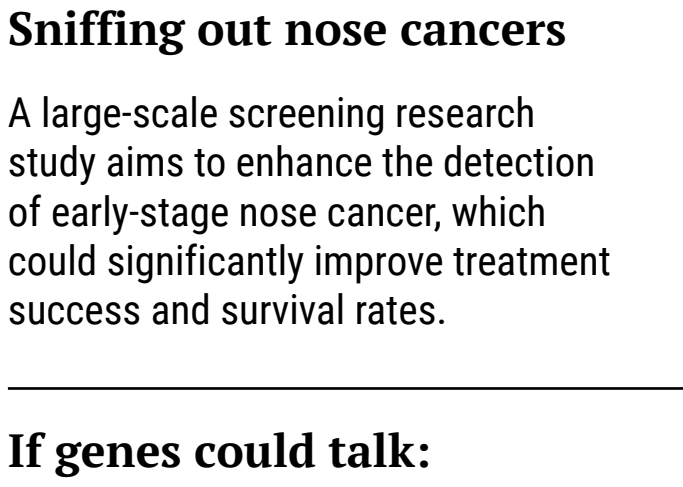
Recovery is the secret to better gains

As sports injuries among youths rise, focusing on the recovery journey becomes critical to avert long-term impacts that could affect both health and athletic potential.



Hearing health on wheels: the drive for accessible audiology care

With new mobile clinics deployed, NUH delivers critical care well within earshot of residents in the western region of Singapore.



Food for thought: healthy eating for healthy living

Embrace the festive season with healthier food choices to nourish and delight, including a turkey recipe that is as nutritious as it is delicious.

Subscribe today!

National University Hospital

Working As ONE TEAM

"Working As One Team" is a series of stories that features how departments build teamwork. The camaraderie leads to a more positive work environment where everyone works towards the shared goal of delivering incredible care to our patients.

Fostering open and transparent communication

Performing over 7,000 surgeries annually, ranging from mild to complex cases, the Department of Ophthalmology bustles with activity all year round. Ensuring everything runs hiccups-free takes a dedicated and responsive team—a feat made possible through open and transparent communication.

A/Prof Victor Koh, the Head & Senior Consultant at the department, attributes their success to a philosophy underpinned by three core pillars: a flat hierarchy, proactive engagement and decisive action.

At the department, an open-door policy is the mainstay. Doing without these "walls" that can sometimes pose as barriers to communication, everyone feels safe to voice their concerns. This is particularly pertinent when making important departmental decisions. "To get everyone's buy-in, we keep an open mind and listen to each idea with intent—even alternative ones—and consider them during the decision-making process," he says. The team also makes it a point to explain why certain decisions are made to maintain transparency.

> **Spending time with colleagues outside of work—enjoying good food, a few drinks and friendly banter—helps to form strong friendships over time. This eventually creates an enjoyable workplace where help is always nearby when needed, allowing us to provide the best patient care possible as a cohesive team.**
>
> *Dr Tong Weihan*
> *Resident*

> **The department has been incredibly supportive, not only in my academic pursuits but also by taking a personal interest in my overall well-being. When I was going through a difficult time balancing exam preparation with caring for a family member with health issues, numerous seniors and peers regularly checked in to see how I was coping. Some even took on several of my administrative duties. Many others also made time in their busy schedules to help with my exam preparation, journeying with me through the ups and downs of residency. I'm beyond grateful to be working with colleagues whom I can also call my friends.**
>
> *Dr Debbie Goh*
> *Resident*

Delivering difficult decisions is never easy. The team believes in filtering these decisions through thorough reasoning and consultation. "When we have to break bad news, we meet with senior figures in the department to seek their advice and explain why the decision is necessary. During the announcement, we outline the underlying reasons and impacts, and demonstrate that other scenarios were considered," A/Prof Victor adds. "If a decision turns out to be wrong, we take accountability and then pivot from there."

This deep-rooted culture of openness has been honed over many years, with efforts made to know team members personally and help them find fulfilment in their roles. This ensures the entire team is aligned and driven by a common goal. "Our predecessors have set the stage, and we continue to make refinements so that we can function even better as a team," adds A/Prof Victor. For example, the HoD works closely with his core team and through the clinical director, Dr Charmaine Chai, implements plans with an active feedback loop and a finger on the pulse.

Looking ahead, the team hopes to continue advocating for staff welfare. As the department grows, bringing in more like-minded individuals who share this culture will be crucial to seizing golden opportunities for departmental improvement.

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Fostering comfort and confidence

When I first joined NUH last year, I struggled with the culture and communication, particularly with my preceptor Ajitha. My anxiety grew until our Nurse Manager asked for feedback and encouraged me to open up. She also arranged for sessions for me to clear the air with Ajitha. The session helped us understand each other better. Now, with my colleagues' support, I feel more confident and motivated to keep going despite the challenges.

Josie Roldan Saba
Staff Nurse

In the Neonatal Intensive Care Unit (NICU), creating a nurturing environment is always top of mind. After all, the nature of the work requires a team that is not only skilled but also supportive and empathetic. Making every team member feel heard, respected and valued is crucial.

The NICU team is characterised by its diverse mix of nationalities. To help new non-local nurses settle in, the leaders including ADoN Lee Heng Pheng, ADoN Sarah Ho-Lim, SNM Roslin Bte Rothman and SNC Lee Soke Lee, make it a point to ensure that they are paired with preceptors from their own country whenever possible. This buddy system makes them feel more at home and supported as they adjust to life in Singapore.

There is a system in place to ensure that new nurses are well supported through regular check-ins with their reporting officers. "As they warm up and get themselves comfortable, they gradually integrate with the rest of the team," says Sarah.

Building confidence is a big focus. Junior nurses are encouraged to share their ideas—fostering an environment where everyone feels their contributions matter. Regular engagement sessions, both formal and informal, play a big part in building this culture.

Conflicts are inevitable in any team, but the NICU team handles them through open dialogue and mutual understanding. In one instance, a junior nurse felt uncomfortable with her preceptor. Rather than swapping preceptors at the get-go, the team arranged to meet the pair to understand their concerns. Through these sessions, both nurses had a chance to see things through each other's lenses—which ultimately helped to strengthen the bond between them.

"When issues are escalated to us, we meet the staff, hear them out and explain what we understand, also asking if there's anything they'd like to add," says Soke Yee. "We encourage them to share their thoughts with us. It's not about making hasty decisions like changing their preceptor at a whim. We know it takes time for some of them to settle in—and so we work with them to find a win-win solution."

Josie had a hard time adjusting when she first arrived—overwhelmed by the fast-paced environment and feeling homesick. Initially, I was not aware that she was intimidated by my approach. After understanding her struggles, I adjusted my teaching methods and was more patient with her. Now, Josie is doing well, and we've grown much closer—sharing both professional and personal difficulties and going on breaks together!

Masilamani Ajitha
Senior Staff Nurse

National University Hospital

"Working As ONE TEAM"

"Working As One Team" is a series of stories that features how departments build teamwork. The camaraderie leads to a more positive work environment where everyone works towards the shared goal of delivering incredible care to our patients.

The three pillars of values, communication, and fulfilment

Having a cohesive and motivated team is the lifeblood of any healthcare setting. At the National University Centre for Oral Health, Singapore (NUCOHS), the team thrives on three key principles: values, communication, and fulfilment.

A respectful and collaborative culture is at the core of the NUCOHS team. Setting the gears of values in motion, the team has restructured itself by breaking down larger teams into smaller, more manageable groups. "In the past, each team had over 20 dental assistants under one leader, which may not be ideal," says Ms Sandy Ho, the Assistant Chief Operating Officer at NUCOHS. "Now every clinic has at least two team leaders, each overseeing about 10 to 12 people. This has improved support and communication within the teams." Additionally, some senior staff have taken on advisory roles, further enhancing team cohesion.

"I've been with the institution for more than 15 years and have worked with many colleagues. One thing has always been constant: teamwork. I've always felt supported, knowing someone has my back. I've had mentors who were patient and kind I strive to be the same to my new colleagues, guiding them with patience and kindness."

Julia Tupari
Assistant Clinic Supervisor

Communication is another cornerstone of NUCOHS's team culture. They keep things lively with bi-weekly and quarterly meetings that reinforce positive behaviours and address issues raised by the staff. These gatherings are a great platform for open dialogue, letting team members voice their concerns and share ideas. The team has put in place a fun, light-hearted internal newsletter that starts conversations about various hobbies and personal interests. "Our newsletter is all about giving everyone a break from the heavy stuff and fostering connections through shared interests," says Sandy.

When it comes to job fulfilment, NUCOHS places a strong emphasis on continuous professional development. Initiatives that have been implemented include a 'Discipline Competency Checklist' to improve technical skills and customised training programmes based on the developmental needs of individual staff. Team members are nominated to be part of workgroups, committees, and projects to hone their leadership skills.

To support wellbeing, NUCOHS organises a plethora of health and wellness activities throughout the year. From team-bonding activities to sports days to celebrations tied to cultural events, the department's yearly calendar is brimming with events to help ensure everyone feel appreciated and connected.

"We had a dialogue session with Senior Management in June where we were encouraged to share our thoughts—work processes, interactions among colleagues, or suggestions for improvement. I find this kind of meet-up to be a nice step towards better collaboration. Our leaders have a better understanding of the challenges we face daily and how they can help create a better workplace."

Doris Foo
Patient Service Coordinator

"In the Central Sterile Supply Department, we're tasked to reprocess instruments for various departments. There was once during the pandemic, when many colleagues were on medical leave, and our steriliser broke down. This could have caused delays in the processing of instruments, and delay in delivery of these items to the departments.

The team came together to help one another and we were able to meet all department requests on time. This incident helped build a stronger bond within the team."

Kartini Bte Mohamed
Senior Health Attendant

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OUR RESEARCH

SDE1 and SDE3 have been extensively rejuvenated to meet educational needs, wellness and stringent sustainability goals. (Photo by Finbarr Fallon)

Integrating Sustainability Initiatives

From revitalising old buildings for enhanced energy efficiency to devising robust climate resilience strategies to powering future-proof data centres, NUS CDE harnesses its extensive intellectual resources across diverse academic disciplines to lead the charge in sustainable development.

In today's increasingly destabilising climate, sustainability is no longer a nice-to-have—it's a crucial pillar underpinning business and governmental operations, the backbone of decision-making for many consumers, and an opportunity for innovators to advance technologies and services that are resilient and adaptive to future challenges. And as the previous year inches towards the warmest on record, obfuscating weather patterns and endangering fragile ecosystems, the need for stronger climate action is more urgent than ever before.

For over two decades, NUS has been steadfast in its pursuit of environmental sustainability, dedicated to driving progress in sustainable development and playing a proactive role in the fight against climate change. In 2023, the university was accorded the prestigious President's Award for the Environment, Singapore's highest accolade for institutions that have made outstanding contributions in the areas of environment and sustainability.

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Subject ranking infographic – option 1

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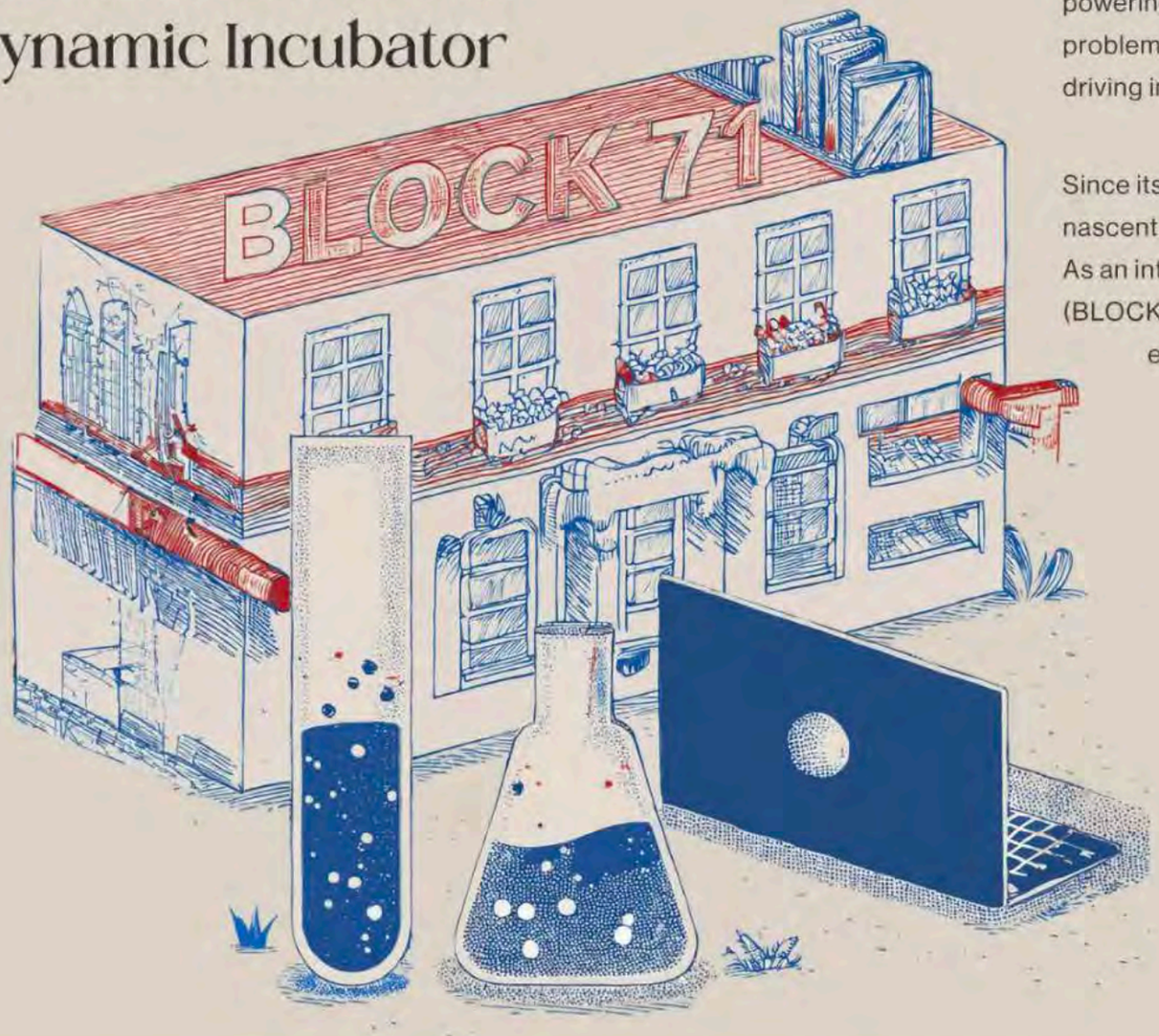
NUS CHINA

2024 ANNUAL REPORT

SUZHOU / CHONGQING / FUZHOU / GUANGZHOU

INNOVATION AND ENTERPRISE

Inventive Solutions, Dynamic Incubator



More than just catalysts for economic growth, today's startups are the engine powering inventive solutions. Not only do they address contemporary problems but they also create new jobs and new products and services, driving innovation and contributing to economic development.

Since its establishment in 2011, NUSRI China has been fuelling the growth of nascent startups through BLOCK71 and has since incubated over 100 firms. As an integral part of NUS' entrepreneurial ecosystem, NUSRI China (BLOCK71) serves as a launchpad for Singapore's deep-tech startups entering the China market, enabling them with extensive resources and business networks to support their growth and market outreach in China.

Spanning diverse sectors from healthcare to immersive technologies, many of these startups have benefited from the incubator, and in this section we feature three such startups and their innovations. We also showcase InnovFest China 2023, an international platform for top-tier technology and business exchange between China and Singapore.

Coastal Protection and Flood Resilience Institute (CFI) Singapore

NUS National University of Singapore | Coastal Protection and Flood Resilience Institute Singapore
College of Design and Engineering

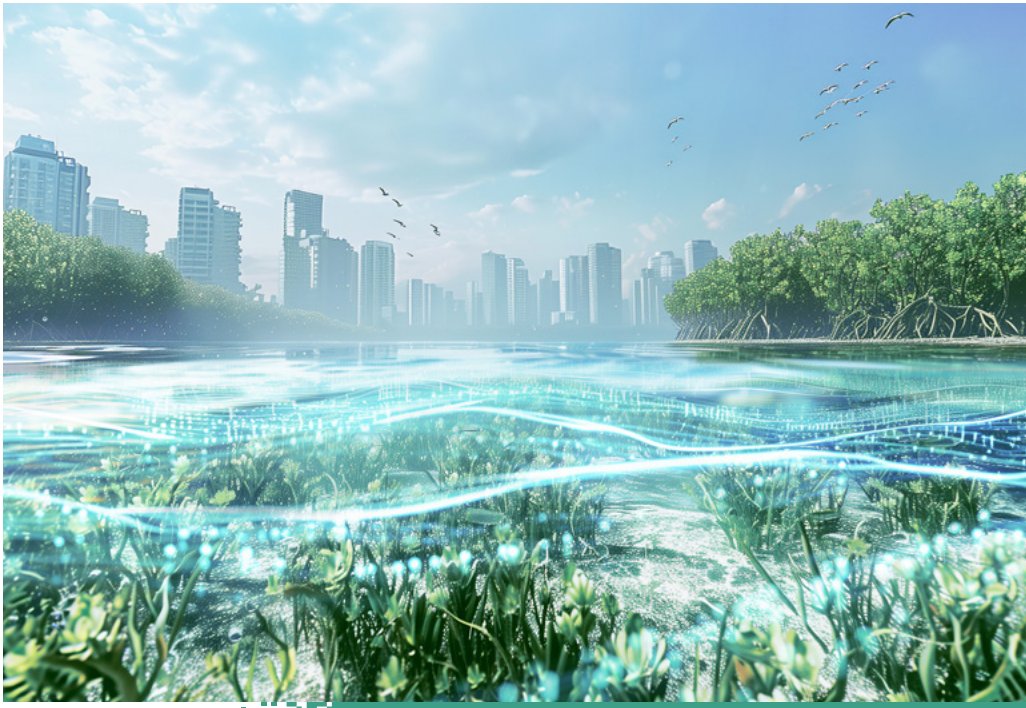
CFI SINGAPORE

Greening Singapore's Grey Shores Through Nature-Based Solutions

Shore protection with integrated nature-based solutions — Eco (SPINS-Eco)

Associate Professor Peter Todd
National University of Singapore, Department of Biological Sciences, College of Humanities and Sciences

Taking a Leaf Out of Nature's Book



Shore protection with integrated nature-based solutions — Hydro (SPINS-Hydro)

Assistant Professor Gary Lei Jiarui
National University of Singapore, Department of Civil and Environmental Engineering, College of Design and Engineering

Keeping the Rising Seas at Bay

Modular solutions to retrofit existing coastal protection structures with impervious interlocking features which reduce seawater seepage

PI: Assistant Professor Chew Soon Hoe
National University of Singapore, Department of Civil and Environmental Engineering, College of Design and Engineering

Data-Driven Rain Prediction

Enhancements of Singapore's convective rainfall prediction

PI: Professor Vladan Babovic
National University of Singapore,
Department of Civil and Environmental Engineering,
College of Design and Engineering

Painting Singapore's Shores Green-Grey

Shore protection with integrated nature-based solutions — Meta (SPINS-Meta)

Associate Professor Peter Todd
National University of Singapore, Department of Biological Sciences, College of Humanities and Sciences

Coastal Protection and Flood Management Research Programme (CFRP) Research Framework

Horizontal 1 | Coastal Science Research

H1 C

- Coastal processes (waves, current, storm surge, sediment transport)
- Extreme event (coupling of intense rainfall runoff and extreme sea levels, joint probability, events attribution)

Vertical 1 | Innovative Engineering Solutions for CP and FM

V1 C A

- Technologies for integrated infrastructure
- Construction techniques in deep waters
- Structural integrity

Vertical 2 | Integrated Nature-based Solutions for CP

V2 A

- Adaptive 'green-grey' hybrid solutions and large-scale testbed
- Framework for long-term monitoring
- Design criteria

Vertical 3 | Sustainable Infra Solutions for CP and FM

V3 A

- Low-carbon materials
- Lightweight, high-strength, corrosive-resistant materials
- Sustainable construction methods

Vertical 4 | Smart Management Solutions for CP and FM

V4 A

- Smart ops and emergency response
- Predictive ops of tidal gates and pumping stations
- Smart system for structural health monitoring

Horizontal 2 | Monitoring, Prediction and Digitalisation of Coastal Environment

H2 C A

- Next-generation sensing technology
- AI, machine learning and physics-informed analytics to process data streams
- Cyber-physical predictive systems to couple advanced numerical simulation research

Horizontal 3 | Integrated and Adaptive Planning

H3 A

- Integrated coastal and urban planning tools
- Systems-level planning framework
- Social science research
- Flood loss curves
- Risk quantification

CP Coastal Protection **FM** Flood Management C Core research A Applied research

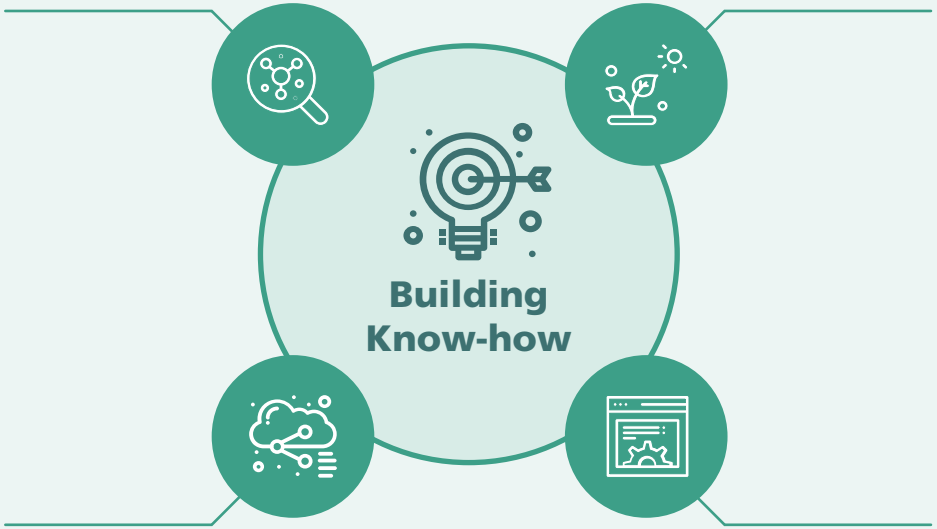
RESEARCH

Coastal Science Research

- High-confidence design parameters for coastal processes
- Impact of climate change on coastal processes
- Impact on coastal protection measures

Integrated Nature-based Solutions

- Develop novel hybrid solutions
- Establish planning guidelines and engineering parameters for hybrid solutions
- Innovative approaches to implement
- Develop science-based monitoring and maintenance approaches

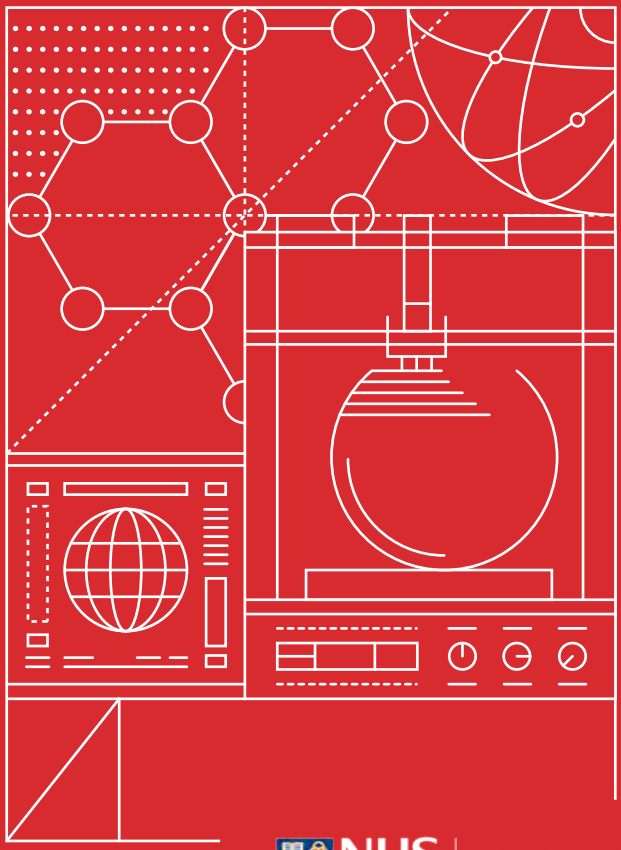


Monitoring, Prediction and Digitalisation of Coastal Environment

- Enhance predictive systems for coastal processes
- Enhance Singapore's convective rainfall prediction
- Enhance predictive systems for runoff generation

Innovative Engineering Solutions

- Adaptive, multi-functional and integrated solutions
- Develop local design standards



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MATERIALS SCIENCE & ENGINEERING

NUS Materials Science and Engineering

From Molecules to Materials to (Engineering) Masterpieces

Why choose NUS Materials Science and Engineering (MSE)?

Innovations in materials science play a crucial role in our modern society, influencing everything from the construction of our homes to the advanced semiconductor technologies that connect us and the biomedical implants that save lives. The materials that shape our world have been meticulously designed and optimised for their specific purposes, with continuous advancements being made. The future holds challenges that will require innovative materials for energy storage in batteries, efficient solar cells, health-enhancing applications and technologies that enrich our daily experiences through improved electronics, safer travel and aesthetic enjoyment.

What Makes Us Different?

MSE Community

Our department admits a select group of around 80 students annually to ensure a personalised and diverse learning experience, supported by a balanced 3:2 male-to-female student ratio.
This approach allows MSE undergraduates the freedom to tailor their studies to their own goals and interests, whether in research, industry or entrepreneurship. Students are encouraged to broaden their horizons through exchange programmes at our overseas colleges or partner universities.

Women in MSE

The field of MSE has seen a significant increase in interest from women, contributing to a more balanced gender ratio within the College of Design and Engineering. This diverse community fosters support and opportunities for women at all levels, from undergraduate and postgraduate students to faculty and alumni, encouraging them to excel and thrive.

Learn From a Nobel Laureate and Other World Experts

Our faculty includes world-renowned experts like Professor Sir Konstantin "Kosyta" Sergeevich Novoselov, a Nobel Prize winner in Physics (2010) for his groundbreaking work on graphene. Professor Novoselov is the first Nobel Laureate to join a Singaporean university. Furthermore, Associate Professor Benjamin Tee's Development of an electronic "skin" that simulates the human sensory system exemplifies the innovative spirit of our department, bringing hope to patients requiring prosthetic limbs.

Career Prospects

The field of MSE is dynamic, continually evolving with the advent of new discoveries and technologies. This evolution promises MSE professionals a career filled with opportunities for lifelong learning and advancement. The versatile skill set acquired through an MSE degree opens doors to a myriad of career paths, with a high employment rate across various sectors, including biomedical, energy, aerospace, microelectronics, AI technologies and beyond.

Graduates from the MSE programme are known for their interdisciplinary knowledge and holistic training, making them highly sought after in sectors such as:

Energy and Utilities: REC Solar, Keppel Energy, Singapore Power

Microelectronics: Micron, GlobalFoundries, AMD, IBM, Apple, UMC, IM Flash Technologies, Seagate, Intel

Aerospace and Defence Technology: Rolls Royce, GE Aviation, Pratt & Whitney, Singapore Technologies, Bombardier, DSTA, DSO

Banking and Investing: Citibank, OCBC, UOB, DBS, Ministry of Finance

Petrochemicals: ExxonMobil, Shell, SCG, Nippon Paint, Johnson Matthey

Research Institutes: A*STAR, SPRING Singapore, DSO, National Labs, local and overseas universities

Transport and Logistics: SMRT, Keppel Shipyard

Life Sciences and Healthcare: Bayer, Ciba Vision, Clarins, Micro Technologies, P&G

Materials Engineering and Industrial Technology: Bosch, Lloyd's Register, Applied Materials, Mitsui Kinzoku, Saint-Gobain, STM Engineering

Tech Companies: Google, Lazada, Shopee, Amazon

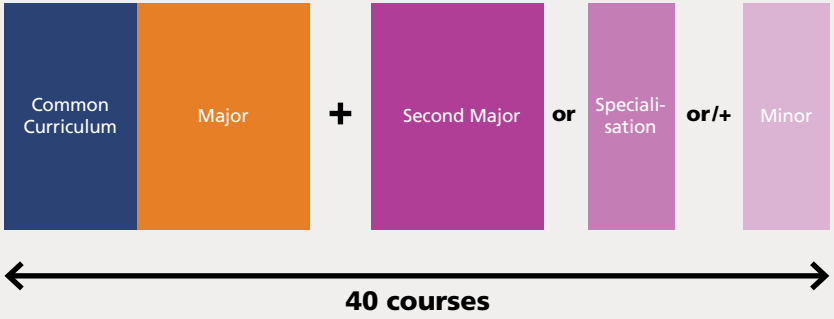
Programme Overview

The MSE programme at NUS is a four-year undergraduate programme that combines a solid foundation in solid-state physics and chemistry with practical aspects of materials design and engineering. Besides theoretical training, experimental work forms a crucial component of the MSE curriculum, paving the way for students to specialise in their desired career paths in research, industry practice or technopreneurship.

The programme has six specialisations:

- Biomedical Materials
- Nanostructured Materials & Nano Technology
- Functional Intelligent Materials
- Materials for Renewable Energy & Sustainability
- Robotics
- Microelectronics & Quantum Materials

Build Your Own Degree



MSE students have the option to expand their expertise through double degrees, second majors or minors in a variety of disciplines:

- BEng Double Degree in MSE with Business Administration
- BEng in MSE and Doctor of Medicine (seven-year programme with Duke-NUS)
- Double major in MSE with Innovation & Design
- Minor programmes are available in Data Engineering, Optics and Semiconductors, Mathematics, Cultural Studies, Technopreneurship, Analytical Chemistry, Physics, Economics, Artificial Intelligence and more.

The programme also offers extensive overseas and industrial opportunities, including:

- Student Exchange Programme (SEP)
- International Summer (& Winter) Programmes (i-SP)
- NUS Overseas Colleges (NOC)
- Other Global Internship experiences

NUS offers financial aids such as bursaries, awards and loans.

For more information, scan this QR code.

Educational Journey

Year 1

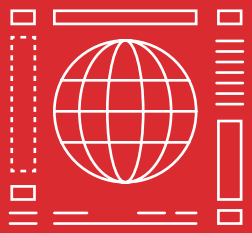
Students begin their journey by establishing a solid foundation in engineering, mathematics and science, complemented by an introduction to data analytics and project management. Engagement in MSE student club activities broadens networks and provides insights into the field, enhancing the campus experience.

Year 2

The curriculum deepens with core principles of Materials Science and Engineering courses, including an introduction to artificial intelligence. The Undergraduate Research Opportunity Programme (UROP) is available for students interested in exploring research opportunities early in their academic career.

Year 3

Opportunities for international exposure are available through student exchange programmes at prestigious universities worldwide. For those interested in entrepreneurship, the NUS Overseas Colleges (NOC) programme offers insights into the startup culture. Industrial attachments and vacation internships provide practical exposure to the materials industries, enriching students' understanding and experience.



Year 4

Students apply their comprehensive knowledge of materials to address industrial challenges. The Final Year Project offers a range of research opportunities, allowing students to explore advanced topics. Hands-on experience in materials processing and exploration of machine learning's impact on materials development equip students with innovative skills in the field.

Profile of Current Students

Loh Jiong Rui

Bachelor of Engineering (Materials Science and Engineering), Class of 2025
Published Review Article on Small Methods

"I chose NUS Materials Science and Engineering as I aspire to play a part in researching new materials to solve challenges from a multidisciplinary lens such as those cited in Michio Kaku's Physics of the Future."

Ian Sim Ee En

Bachelor of Engineering (Materials Science and Engineering), Class of 2024
E-Scholar

"The interdisciplinary nature of MSE blends the theoretical aspects of the sciences with the practical principles of engineering, providing a dynamic learning environment for me to better understand how our world works and develop innovations to improve our everyday quality-of-life."

Ian Tay Rongde

Bachelor of Engineering (Materials Science and Engineering), Class of 2025
E-Scholar

"Science and technology have always been essentials in opening up new possibilities for humankind. Through MSE, I hope to be able to develop materials that can expand the frontiers of technology."

Dang Thanh Ly, Althea

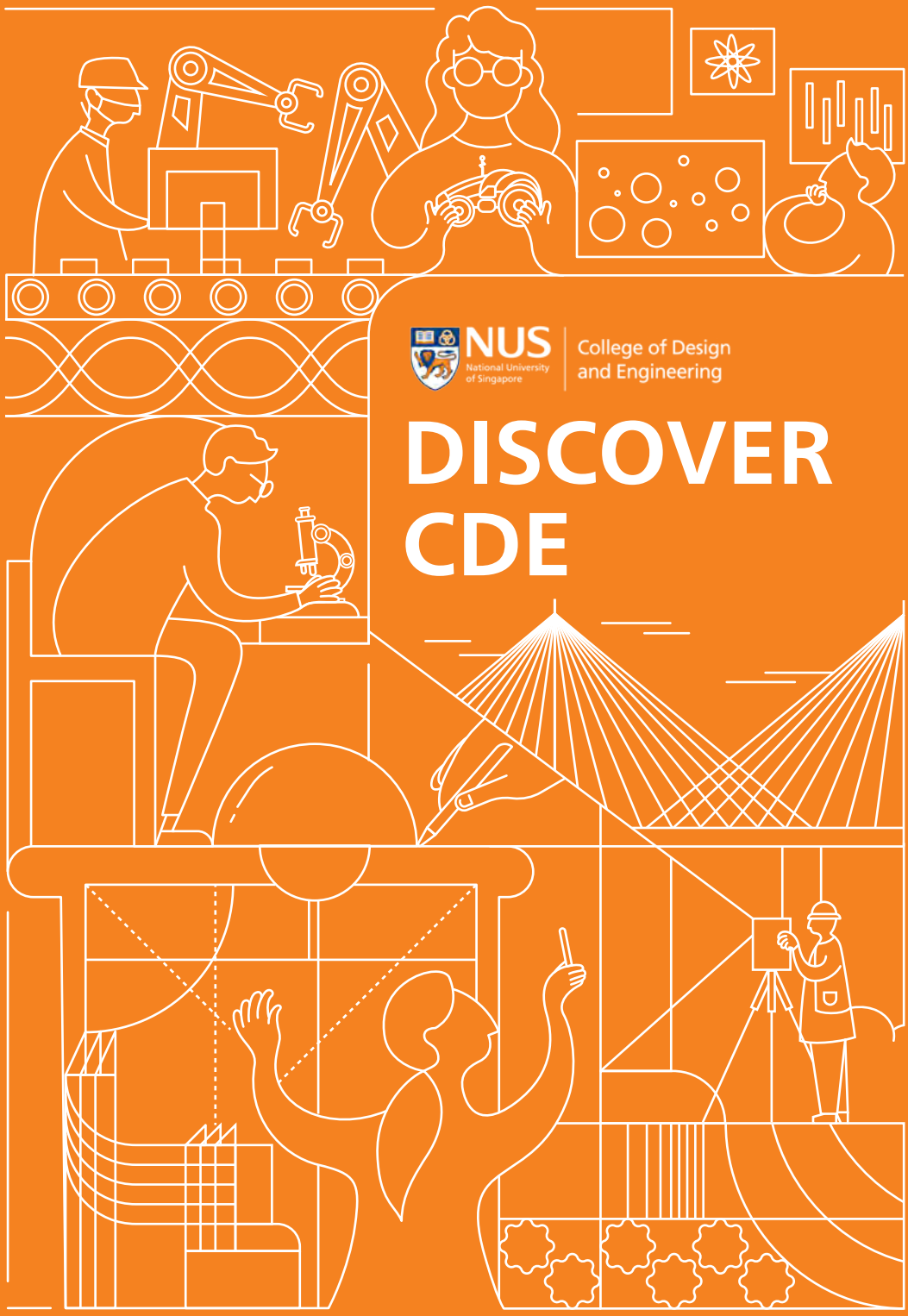
Bachelor of Engineering (Materials Science and Engineering), Class of 2027
National Bowler

A national bowler who represented Singapore to win many international bowling competitions, Althea developed a passion in chemistry at a young age, and a keen interest in how drugs function to help people. She credits her success in balancing both sports and studies to the support of her coaches and her teachers.

Harini Ravichandran

Bachelor of Engineering (Major: Materials Science and Engineering/Second Major: Innovation & Design), Class of 2026

Entering the Materials Science and Engineering (MSE) programme has been transformative for me from the very beginning. The warm reception and unwavering support from our professors and department have made me feel truly valued and encouraged to pursue my research interests. MSE's diverse applications across industries such as semiconductors, biomedical engineering, and robotics, as well as its presence in leading companies like Apple, Dyson and 3M, highlight the breadth of opportunities available in this field. The tight-knit community within MSE has not only equipped me with valuable knowledge but also fostered a network of peers and professionals that I believe will be instrumental in shaping my future endeavors, whether in the working world or further academic pursuits.



NUS National University of Singapore | College of Design and Engineering

DISCOVER CDE

Contents

All information contained is accurate at the time of publication in February 2024.
Do check our website for updates if any.

CDE is Globally Recognised

NUS emerged **eighth** in the latest UK-based **Quacquarelli Symonds (QS) World University Rankings 2024**.

NUS is the **highest-ranked Asian university** and the **first from Asia** to place among the top 10 institutions in the world. That's not all — CDE also shines in the subject-specific rankings.

8th in the world

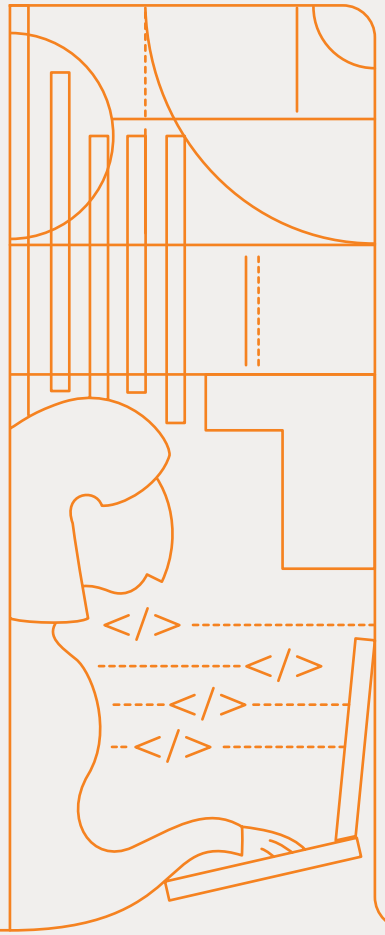
1st in asia

The CDE Edge

When you pursue a four-year direct Honours degree at CDE, you gain breadth, depth and flexibility through a combination of the **common curriculum**; a **major** of your choice; and a wide range of **unrestricted electives**.

200 Second Majors and Minors

30 Specialisations



Unrestricted Electives — 10 courses

+

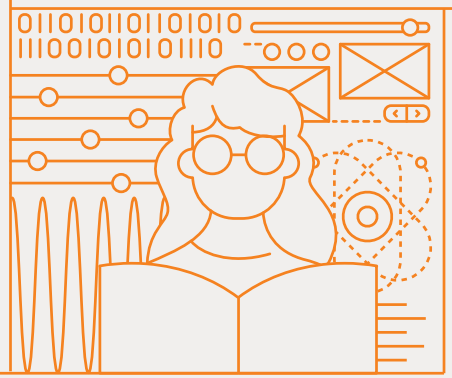
Primary Major — 15 courses

+

Common Curriculum — 15 courses

The CDE Edge

Common Curriculum — 14 pillars to give you a solid foundation so you can maximise opportunities to advance your career, regardless of your discipline. We emphasise instilling lifelong skills in data and digital literacy, systems thinking, design thinking and critical thinking.



Artificial Intelligence

Communities & Engagement

Creating Narratives

Critique & Expression

Cultures & Connections

Data Literacy

Design Thinking

Digital Literacy

Maker Space

Project Management

Singapore Studies

Sustainable Futures

Systems Thinking

Integrated Project

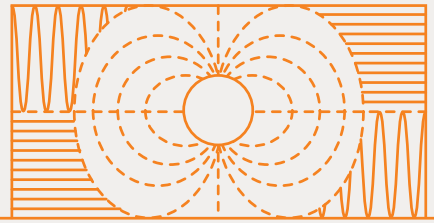
Primary Major — 15 courses to provide an in-depth education in your selected discipline among the **14 degree programmes** at CDE. We'll take care of equipping you with relevant competencies from theory to practice — you only need to choose the field in which you will thrive in the future:

Direct Admissions

- Architecture (BA)
- Landscape Architecture (BLA)
- Industrial Design (BA)
- Computer Engineering (BEng)

Common Admissions (Engineering)

- Biomedical Engineering (BEng)
- Chemical Engineering (BEng)
- Civil Engineering (BEng)
- Electrical Engineering (BEng)
- Engineering Science (BEng)
- Environmental Engineering (BEng)
- Industrial and Systems Engineering (BEng)
- Infrastructure and Project Management (BEng)
- Materials Science and Engineering (BEng)
- Mechanical Engineering (BEng)



Unrestricted Electives — 10 courses to expand your horizons, with over 4000 options across CDE and NUS at your fingertips. We believe in giving you the freedom to personalise your learning to align with your interests. This is your education, the way you always envisioned it.

- **Design Your Own Course (DYOC):** Flex your creativity by choosing what you want to learn, how you want to learn it, and who you will learn from (maximum of two courses).
- **Second Major:** Master dual disciplines by pursuing a second major suiting your professional goals. Note: it is a non-honour major with a lower unit requirement than that of your primary major.
- **Minor:** Intrigued by more than one programme? Take a minor (or two!) to explore an additional area beyond your major, within or outside of CDE.
- **Specialisation:** Deepen your knowledge and focus on a particular niche in your chosen field. Combine it with another specialisation or minor to tailor your education to your needs.
- **Research Experience:** Step beyond the four walls of the classroom and learn by doing when you engage in cutting-edge research and innovation projects within CDE.

Building Your CDE Degree

What does an education at CDE entail?

An education at CDE will be an exciting, interdisciplinary experience for students where their learning journey takes centre stage. We are equipping students with an adaptable toolbox of skills across disciplines, moving them beyond a knowledge-based education to a mindset-based approach to problem-solving. The CDE common curriculum provides a broad intellectual foundation on which you can continuously upgrade, evolve and re-pivot in a fast-changing world. Our Majors build on top of the common curriculum to allow you to explore your chosen field, and our unrestricted elective space gives you the freedom to customise your educational experience.

What is Build Your Own Degree? How do Unrestricted Electives work?

Each of our undergraduate degrees is a four-year direct honours degree and you need an equivalent of 40 courses to graduate. Your major is your primary area of study, comprising 15 courses. The Common Curriculum accounts for another 15 courses. This leaves 10 courses in the Unrestricted Electives (UE) space that you can use to decide how broad, deep or integrated you want your education to be. You can choose what you want to take from anywhere at NUS. Second majors (10 courses) and minors (5 courses) allow you to broaden your knowledge and skills in a complementary or contrasting area. A specialisation (5 courses) is a focus area within your chosen discipline. Alternatively, you can choose from over 4000 courses available across NUS as electives based on your interest.

Planning Your CDE Journey

What courses do we need to take each year in CDE? Is there a curriculum schedule assigned to students?

Some courses under the Common Curriculum will be pre-allocated to students. Each programme also has a recommended curriculum schedule that students can use to plan the courses they need to take each semester. You may then ballot for the courses you want during the course registration exercise before each semester. The recommended schedule is available on each department's website.

What are the other opportunities available to CDE students?

CDE and the wider NUS community offer a wide range of global opportunities and special programmes to enhance your learning experience such as the NUS Overseas Colleges, Residential Programmes, Student Exchange Programme and Summer/Winter Schools. Those interested in NUS College will be pleased to know it is compatible with all CDE degree programmes. Beyond academics, we have a vibrant College life and offer a wide range of activities from wellness workshops to cooking lessons. With NUS' huge range of clubs and societies there is never a problem with finding your niche!

Key Activities During The Academic Year

June

Orientation

Orientation marks the beginning of the freshmen's journey with an enriching lineup of social engagement activities

July

Start of Sem 1

Freshman Welcome

Welcoming the freshmen to their respective departments and being a part of NUS CDE community

May

End of Sem 2 (After exams)

Vacation 12–13 weeks

August

Star Awards

Honours the students (individuals or groups) for their passion, talent, contributions & achievements for the faculty and the community at large.

September

Career Fair

Platform for students to engage key employers with exciting career opportunities.

January

Start of Sem 2

CDE Day

A day of college student celebration to build a vibrant and cohesive community

Student Life Events

All other student clubs' communications and activities

October

Sem 1

Community Day

A day of promoting and building social connectedness and community network