Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Engineering
Eyobunjineli
Ingenieurswese

2024 | ANNUAL REPORT JAARVERSLAG





forward together
sonke siya phambili
saam vorentoe

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At a **glance**

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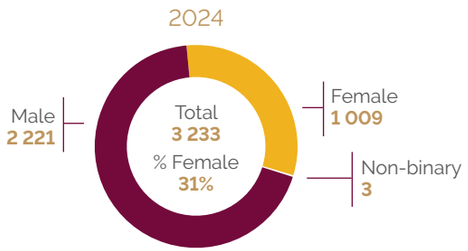
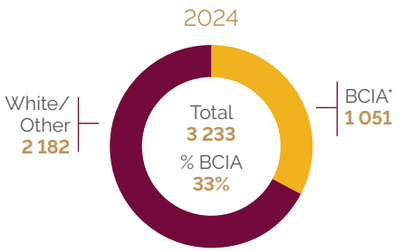
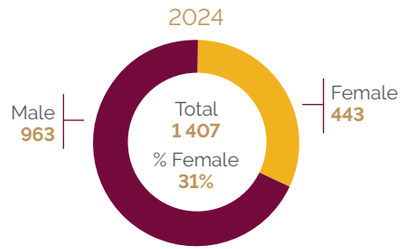
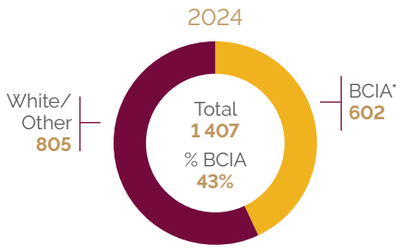




Postgraduate Student **Demographics**



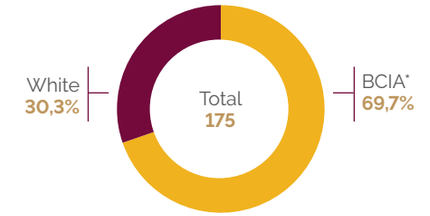


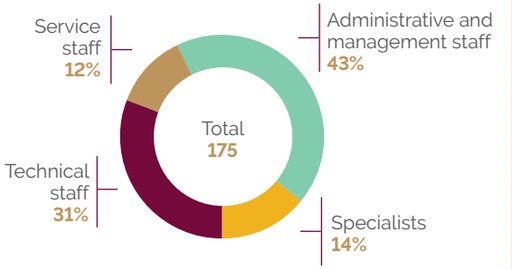
Academic Staff

170 permanent academic staff

*BCIA = Black African, Coloured, Indian and Asian

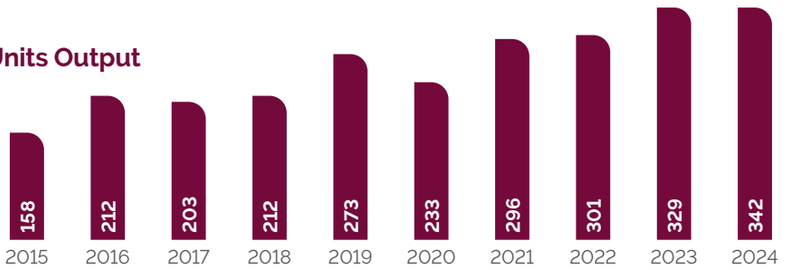
Support Staff





872 Graduates (Dec 2024 & March 2025)

Publication Units Output



65 NRF-rated Academics 2024

Celebrating 80 years of **excellence**

Current Dean Prof Wikus van Niekerk (centre) stands with former deans Profs PW van der Walt, Arnold Schoonwinkel and Hansie Knoetze. Also pictured are acting deans Profs Celeste Viljoen (second from the right) and Petrie Meyer (far right) from 2024.

In 2024, the Faculty of Engineering at Stellenbosch University celebrated its 80th anniversary, marking eight decades of academic excellence, innovation and social impact. To commemorate this milestone, the Faculty launched a dedicated anniversary webpage, hosted celebratory dinners for staff and organised a prestigious gala event attended by distinguished guests and alumni. Among the alumni were notable pioneers, such as Mrs Isa Thompson, the first woman to graduate with an engineering degree (BEng (Civil) in 1973), and Mr Henry Green, the first person of colour to earn a bachelor's degree at the University (BEng (Electronics) in 1979). Besides honouring past achievements, these celebrations anticipated an exciting future as the Faculty continues to excel in engineering education, research and industry collaboration.

A transformative, inclusive student experience

At the heart of our Faculty's success is our commitment to providing an enriching, supportive environment that transforms students into confident, capable engineers. This year, we welcomed some of South Africa's top matriculants, evidence of the Faculty's growing appeal.

Our student recruitment efforts are more inclusive and engaging than ever. Mr August Engelbrecht, our dedicated recruiter, orchestrated a telethon where fifteen current students connected with provisionally accepted applicants in their home languages, sharing honest insights about life as engineering students at Stellenbosch and easing their transition into university. This approach demonstrates our commitment to diversity and ensuring every student feels welcomed and supported.

The 2024 Data School Hackathon highlighted our students' ability to solve real-world problems under pressure, with teams delivering impressive solutions under tight deadlines. Our students' successes reflect the Faculty's focus on preparing graduates to meet the demands of the global engineering landscape.

Networked and collaborative teaching and learning

The Faculty continues to innovate teaching and learning by embracing collaborative and networked approaches that connect students and staff across disciplines and institutions. Our MEng in Engineering Management programme delivered its first graduates. This innovative, hybrid programme bridges engineering and management, preparing graduates for leadership roles in industry.

Our accreditation by ECSA ensures our programmes meet the highest standards while staying aligned with evolving industry demands.

Research for impact

Research drives our mission to address society's critical challenges. Our NRF-rated researchers grew from 54 to 65, with two researchers achieving A ratings. The Faculty awarded 68 doctorates, leading all faculties at the University.

Our "Research for Impact" webpage highlights groundbreaking work across disciplines. Highlights include a study revealing hidden health risks associated with indoor fireplaces, advancements in fire engineering through industry collaboration, and pioneering research in machine learning for speech processing. Inter-faculty projects explore neurodegenerative diseases at the cellular level, and Mariner 4.0 technology assists seafarers in combating seasickness.

New research chair appointments, including Prof Lijun Zhang as SU's Robotics Chair and Prof Pieter Rousseau as the Voigt Chair in Thermofluid Systems Modelling, underscore our dedication to cutting-edge research.

Purposeful partnerships and inclusive networks

The Faculty of Engineering fosters meaningful partnerships that enhance teaching, research and social impact. Our collaboration with the Council for the Built Environment fosters interdisciplinary projects addressing real-world challenges. The Department of Chemical Engineering's valorisation of paper pulp waste into bioethanol project had the benefit of strong cooperation with industry and government.

Community engagement is a priority, exemplified by the Rail Safety Campaign, which won the Stellenbosch University Social Impact Award, highlighting how engineering solutions directly contribute to societal well-being.

Our partnerships span local and international networks, expanding opportunities for staff and students and ensuring our research, teaching, and innovation remain globally relevant and socially responsible.

Stellenbosch University as an employer of choice

Our reputation as an employer of choice continues to grow, reflected in an increase in permanent academic staff – from 164 in 2023 to 170 in 2024. Of these, 137 hold PhDs and 71 are registered Professional Engineers, strengthening our teaching expertise.

Three remarkable academic leaders delivered inaugural lectures, sharing their vision and expertise: Prof Stephen Matope and Prof Sara Grobbelaar in Industrial Engineering, and Prof Christie Dorfling in Chemical Engineering.

Mr Masiyiwa received an honorary doctorate in Engineering from Stellenbosch University in December 2024.

At our 2024 Faculty of Engineering Awards, Dr Melody Neaves and Prof James Bekker received Teaching Excellence Awards, Dr Boitumelo Ramatsetse an Emerging Researcher Award and NRF Research Excellence Award for Early Career Researchers, and Prof Japie Engelbrecht was honoured as Lecturer of the Year.

Dr Philani Zincume received the prestigious Prof Paul Kruger Award for Excellence in Teaching and Learning from the Southern African Institute for Industrial Engineering, acknowledging his outstanding contributions to operations management education.

A thriving Stellenbosch University

Ongoing upgrades through the Engineering Campus Renewal Project are enhancing the campus experience for both students and staff. The Department of Electrical and Electronic Engineering moved back into their refurbished facilities and construction started on the General Engineering Building.

Sustainable innovations, such as the Department of Industrial Engineering's converting an old commuter diesel bus to electric power, demonstrate our commitment to environmental responsibility and practical engineering solutions.

Our annual Industry Showcase strengthens industry ties, ensuring that graduates are work-ready and that research aligns with economic needs.

Together, these initiatives reinforce the Faculty's role as a vibrant and essential part of Stellenbosch University, driving innovation, inclusivity and social impact.

Looking forward

Celebrating 80 years of academic excellence and innovation, the Faculty is well positioned for a future of continued growth, relevance and impact. Our transformative student experiences, collaborative teaching, impactful research and strong partnerships underpin our commitment to excellence and inclusivity. The Faculty looks forward to shaping the engineers and leaders of tomorrow for many decades to come.

80 jaar van **uitnemendheid**

In 2024 vier die Fakulteit Ingenieurswese aan die Universiteit Stellenbosch sy 80ste bestaansjaar en huldig daarmee agt dekades van akademiese uitnemendheid, innovasie en sosiale impak. Ter herdenking van hierdie mylpaal het die Fakulteit 'n jaarfees-webwerf gepubliseer, feestelike dinees vir personeel gehou en 'n voortreflike galageleentheid aangebied wat deur vooraanstaande gaste en alumni bygewoon is. Onder die alumni was merkwaardige voorlopers, soos me Isa Thompson, die eerste vrou wat 'n ingenieursgraad ontvang het (BIng (Siviel) in 1973), en mnr Henry Green, die eerste persoon van kleur wat 'n baccalaureusgraad aan die Universiteit ontvang het (BIng (Elektronika) in 1979). Benewens eerbetoning aan vorige prestasies, sien ons met hierdie viering uit na 'n opwindende toekoms waarin die Fakulteit voortgaan om uit te blink in ingenieursopleiding, navorsing en samewerking met die bedryf.

'n Transformerende studente-ervaring

Die kern van ons Fakulteit se sukses is ons verbintenis om 'n verrykende en ondersteunende omgewing vir ons studente te skep waarin hulle kan transformeer tot selfversekerde, bekwame ingenieurs. Vanjaar het van Suid-Afrika se beste matrikulante by ons ingeskryf, 'n teken van die Fakulteit se versterkende aantrekkingskrag.

Ons studentewerwingspogings raak al hoe meer persoonlik en inklusief. Mnr August Engelbrecht, ons toegewyde werwingsbeampte, het vyftien ingenieurstudente ingespan om via teleton uit te reik na voorwaardelik aanvaarde voornemende studente in hul moedertaal. Hulle het eerlike perspektiewe op die universiteitslewe as ingenieurstudente op Stellenbosch gedeel en sodoende die nuwelinge se aanpassing by die universiteitslewe vergemaklik. Hierdie benadering demonstreer ons verbintenis tot diversiteit en verseker dat elke student welkom en ondersteun voel.

Die 2024 Dataskool 'Hackathon' het ons studente se vermoë om werklike probleme onder spanning aan te pak belig, met spanne wat indrukwekkende oplossings binne knap spertye bedink het. Ons studente se suksesse weerspieël die Fakulteit se fokus op die voorbereiding van graduandi vir die uitdagings van die globale ingenieurslandskap.

Genetwerkte en samewerkende onderrig en leer

Die Fakulteit innoveer sy leer en onderrig voortdurend deur netwerking en samewerking aan te moedig waardeur studente en personeel dwarsoor dissiplines en instellings saamspan. Ons MIng-program in Ingenieursbestuur het sy eerste gegradueerdes opgelewer. Hierdie innoverende, hibriede program oorbrug ingenieurswese en bestuur, en berei graduandi voor vir leierskaprolle in die bedryf.

Ons akkreditasie deur ECSA verseker dat ons programme aan die hoogste standaarde voldoen en steeds gerig is op ontwikkelende bedryfsbehoeftes.

Navorsing vir impak

Navorsing dryf ons missie om die samelewing se kritieke uitdagings die hoof te bied. Ons NNS-graderings het van 54 tot 65 vermeerder, waaronder twee navorsers met A-graderings. Die Fakulteit het 68 doktorsgrade toegeken, waarmee hy al die ander fakulteite uitstof.

Ons "Navorsing vir Impak"-webbladsy bring ons baanbrekerwerk oor dissiplines heen na vore. Hoogtepunte behels 'n studie wat die verborge gesondheidsrisiko's van binnenshuise vuurherde blootstel, vooruitgang in brandingenieurswese deur bedryfsamewerking, en voorpuntnavorsing in masjienleer vir spraakprosessering. Interfakultêre projekte ondersoek neurodegeneratiewe siektes op sellulêre vlak en Mariner 4.0-tegnologie help seevaarders om seesiekte te beheer.

Nuwe navorsingsleerstoele, waaronder prof Lijun Zhang in die Universiteit se Robotikaleerstoel en prof Pieter Rousseau in die Voigt Leerstoel vir Termovloeisisteemmodellering, onderstreep ons verbintenis tot voorpuntnavorsing.

Doelgerigte vennootskappe en inklusiewe netwerke

Die Fakulteit Ingenieurswese sluit betekenisvolle vennootskappe wat onderrig, navorsing en sosiale impak versterk. Ons samewerking met die Raad vir die Bou-omgewing fasiliteer interdissiplinêre projekte wat werklike uitdagings die hoof bied. Die Departement Chemie se benutting van papierpulpafval deur die onttrekking van bioetanol trek voordeel uit die nou bande met ons bedryfs- en regeringsvennote.

Gemeenskapskakeling geniet voorrang, soos blyk uit die Spoorveiligheidsveldtog wat die Universiteit Stellenbosch Sosialeïmpaktoekenning gewen het. Hierdie glanspunt toon hoe ingenieursoplossings direk bydra tot die welstand van die gemeenskap.

Sulke vennootskappe strek oor nasionale grense heen en gee ons studente en personeel toegang tot globale netwerke en hulpbronne. Só verseker ons die relevansie en impak van ons navorsing.

Die Universiteit Stellenbosch as voorkeurwerkgewer

Ons reputasie as 'n voorkeurwerkgewer bly groei soos blyk uit 'n toename in permanente akademiese personeel — van 164 in 2023 tot 170 in 2024. Onder hulle tel 137 gedoktoreerdes en 71 geregistreerde Professionele Ingenieurs wat ons onderrigkundigheid versterk.

Met hul intreeredes deel drie merkwaardige akademiese leiers hul visie en kundigheid: prof Stephen Matope en prof Sara Grobbelaar in Bedryfsingenieurswese, en prof Christie Dorfling in Chemiese Ingenieurswese.

By die Fakulteit Ingenieurswese se 2024-toekennings het dr Melody Neaves en prof James Bekker Uitnemendheidstoekennings in Onderrig ontvang, dr Boitumelo Ramatsetse die Opkomendenavorsertoekenning benewens die NNS se Navorsinguitnemendheidstoekenning vir Vroeëloopbaannavorsers, en is prof Japie Engelbrecht gehuldig as Lektor van die Jaar.

Dr Philani Zincume ontvang die hoog aangeskrewe prof Paul Kruger-toekenning vir Uitnemendheid in Onderrig en Leer van die Suider-Afrikaanse Instituut vir Bedryfsingenieurswese ter erkenning van sy uitstaande bydraes tot operasionelebestuursonderrig.

'n Florerende Universiteit Stellenbosch

Voortgaande infrastruktuuropgraderings as deel van die Ingenieurskampusvernuwingsprojek verbeter ons studente en personeel se kampuservaring. Die Departement Elektriese en Elektroniese Ingenieurswese het na hul opgeknapte fasiliteite teruggetrek en konstruksiewerk aan die Algemene Ingenieursgebou kon begin.

Volhoubare innoverings demonstreer ons verbintenis tot omgewingsverantwoordelike en praktiese ingenieursoplossings, byvoorbeeld die Departement Bedryfsingenieurswese se omskakeling van 'n ou dieselaangedrewe pendelbus na elektriese aandrywing.

Ons jaarlikse Bedryfsuitstalling versterk ons bande met die bedryf en verseker dat ons gegradueerdes werkgereed is en ons navorsing aan die ekonomie se behoeftes voldoen.

Al hierdie inisiatiewe bevestig die Fakulteit se rol as 'n dinamiese en essensiële deel van die Universiteit Stellenbosch waardeur hy innovering, inklusiwiteit en sosiale impak aandryf.

Toekomsblik

Met die viering van 80 jaar van akademiese uitnemendheid en innovering is die Fakulteit goed geposisioneer vir 'n toekoms van volgehoue groei, relevansie en impak. Ons transformerende studente-ervarings, samewerkende onderrig, navorsingsimpak en sterk vennootskappe ondersteun ons verbintenis tot uitnemendheid en inklusiwiteit. Die Fakulteit sien daarna uit om die toekomstige ingenieurs en leiers vir nog vele dekades te vorm.

Voornemende ingenieurstudente wat uitgeblink het in die Nasionale Senior Sertifikaat, staan by die Fakulteit Ingenieurswese se Dekaan, prof Wikus van Nierkerk, en Vise-Dekaan, prof Celeste Viljoen (middel).

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DEPARTMENT OF **CHEMICAL ENGINEERING**

Chemical Engineering at Stellenbosch University remains a beacon of academic and practical excellence. Essential for creating safe, sustainable and profitable industrial processes, chemical engineering promotes a sustainable future by optimally using bioresources. Our researchers teach students to develop beneficial processes and apply technologies in full-scale production. Master's students Raissa Kenmene and Mellisa Ncube (above) demonstrate the solvent extraction of antioxidants from plants to improve waste management.

Left: Dr Margreth Tadie (on the left) and Cara Haller at the International Mineral Processing Congress.
Right: Thaakira Jabaar at the Global Congress of Chemical Engineering.

Chemical Engineering students **strengthen Stellenbosch University's reputation**

Locally and abroad, innovative scholars in chemical engineering are recognised for their excellence.

At Stellenbosch University's annual Research and Innovation Excellence Awards, two chemical engineering candidates were honoured for their contributions to cementing the University's reputation as a leading research-intensive institution. Postdoctoral fellow **Dr George Mbella Teke** was among the Deputy Vice-Chancellor's top five recipients of Postdoctoral Awards for his contributions to bioreactor design and processes in chemical engineering. **Jan-Hendrik Duminy** received one of the eight Postgraduate Student Awards for his research towards a Master of Chemical Engineering degree on valorising a wax by-product from commercial cannabis processing. His supervisor was Prof Neill Goosen.

On the international scene, two chemical engineering postgraduate students, Cara Haller and Thaakira Jabaar, received accolades at renowned international conferences for their outstanding research contributions to sustainability.

PhD candidate **Cara Haller** was honoured with the prestigious Young Author Award at the XXXI International Mineral Processing Congress (IMPC) in Washington, USA. This award, presented to the ten most outstanding papers authored by researchers under 35, recognises Haller's pioneering work on sustainable lithium extraction methods. This work holds promise for reducing the environmental impact of lithium production, a critical material for electronics, electric vehicles and renewable energy storage systems. Her co-author and supervisor was Prof Christie Dorfling.

Master's student **Thaakira Jabaar** also achieved international recognition by winning the Best Oral Presentation Award at the Global Congress of Chemical Engineering (GCCE). Held in Cape Town, it marks the first-ever GCCE held on African soil. Jabaar's research identified decay factors specific to paper in South Africa, providing the pulp and paper industry with accurate data for waste management and sustainability planning. This could lead to improved greenhouse gas reporting, reduced emissions and better environmental compliance.

Data Analytics offers tailor-made solutions for industrial processes

While professionals in the chemical engineering industry see the potential of data science to support their operations when optimising or troubleshooting processes, they find standard data science techniques unsuitable for typical chemical plant data. According to Prof Tobi Louw, a professor at the Department of Chemical Engineering and a specialist in machine learning for process monitoring and control, "The industry needs chemical engineers with a fundamental understanding to adapt these methods to their specific needs."

To equip chemical engineers with the knowledge and skills necessary to unlock the power of data analytics, the Department of Chemical Engineering launched a new Structured MEng in Chemical Engineering degree programme with Data Analytics as a focus area, led by Prof Louw. To accommodate working engineers, the programme is offered in a hybrid mode, with the option of full-time study over two years or part-time study over three years. Eighteen inaugural students have since completed the first year and are now enrolled in the second year.

Extending the opportunity to professionals from various industries to bridge the knowledge gap, Prof Louw and Prof Lidia Auret presented an online workshop on exploratory data analysis for industrial processes. The event was part of a series organised by the South African Council for Automation and Control (SACAC). Prof Auret holds an extraordinary associate professorship at the Department, in addition to her full-time role as senior process data scientist at Stone Three Digital, a company that offers end-to-end digital solutions for heavy industries.

The workshop, held in March 2024, introduced participants to the practicalities of industrial data. Topics included the nature of process datasets, working with time series data, dimensionality reduction and visualisation, as well as clustering and model interpretation using tree-based methods.

Participants expressed appreciation for the workshop's practical relevance, well-structured format and valuable insights, which effectively simplified complex concepts and provided appreciated resources for further learning.

The success of this workshop demonstrates the Department's dedication to sharing knowledge and skills with industry professionals.

Staff acknowledged for **innovation and research excellence**

The recognition of our staff's outstanding contributions underpins the Department of Chemical Engineering's commitment to nurturing top-tier research talent.

Prof Robert Pott (left) and Dr Jamie Cripwell (right).

Stellenbosch University's Innovus Technology Transfer Office honoured Prof Robert Pott with a Research Innovator Award at their 2024 Innovus Inventors Awards. With this award, Innovus celebrates researchers who have submitted the most actionable disclosures over the past five years, turning their groundbreaking research into real-world impact.

Prof Pott's fields of interest include biofuels, bioreactor optimisation and waste beneficiation. These fields are integral to advancing sustainability, as they focus on reducing environmental impact and promoting resource efficiency.

Two members of the Department received a new research rating or had their rating improved. The National Research Foundation (NRF) in South Africa evaluates researchers against global standards by considering the quality and impact of their recent research outputs.

Dr Jamie Cripwell, a senior lecturer at the Department, received the Y1 rating in the Promising Young Researchers category. The Y1 rating is granted to young researchers under the age of 35 and within 5 years of earning their PhD, who reviewers identify as having the potential to emerge as future leaders in their field. He is a member of the Separations Technology and Machine Learning research groups in the Department, where he integrates machine learning with thermodynamics in his research activities.

Prof Johann Görgens, a distinguished professor in biorefineries, techno-economics and bioprocessing, improved his rating to B1. NRF reviewers allocate this rating when the applicant enjoys considerable international recognition for the high quality and impact of their recent research outputs.

Pioneering solution transforms waste into bioethanol

Left: The ethanol demonstration plant at the Sappi Tugela mill.
Right: Reels of packaging paper ready to be converted into boxes and other paper packaging by Mpact.

A groundbreaking solution to convert waste from paper mills into bioethanol was developed through a collaboration between the Department of Chemical Engineering, the Paper Manufacturers Association of South Africa (PAMSA), Sappi Southern Africa and Mpact. This process turns cellulose fibre-rich waste into ethanol, which can be used for industrial chemicals, bio-based plastics and sustainable aviation fuel.

On 24 April 2024, a demonstration plant, co-funded by the Department of Science and Innovation (DSI) and PAMSA, was inaugurated at the Sappi Tugela mill in KwaZulu-Natal. The facility, equipped with a 1 000-litre bioreactor, processes 100 kg of paper sludge daily, effectively showcasing the commercial readiness of the fermentation technology. Following a nine-month operational period at the Tugela mill, the plant will be relocated to Mpact's mill in Springs, Gauteng, for further evaluation.

The technology originated from a master's research project and was further developed over 10 years by the Department's Bioresource Engineering Group. "We have explored various beneficiation routes to create an application for this by-product of paper-making processes," explained project leader Prof Eugene van Rensburg, adding that the same fermentation process can handle food, clothing or textile waste without pre-treatment.

Dr Mmboneni Muofhe, Deputy Director-General for Socio-Economic Innovation Partnerships at the DSI, attended the inauguration and expressed optimism about the long-term value of such initiatives: "Through continued partnerships and pioneering initiatives like this, we are confident in our ability to ensure a growing role for science, technology and innovation in the reconstruction of South Africa's economy through circularisation and modernisation of manufacturing."

Giovanni Sale, the senior general manager for sustainability at the Sappi Technology Centre, said, "This initiative not only addresses the pressing issue of waste management but also reduces the associated environmental impacts and costs, while unlocking economic opportunities and promoting responsible consumption and production."

This solution has the potential to generate upskilling opportunities and sustainable employment, stimulating regional economic development. It holds substantial economic promise as waste-derived bioethanol commands premium prices in global markets. At the same time, it will help reduce landfill waste and greenhouse gas emissions, replace fossil fuels and improve water reclamation, further contributing to a circular economy.

Research **Output**

78	7	11	36
Subsidised Journal Articles	International Proceedings	Doctorates	Master's Degrees

Research **Themes**

Extractive Metallurgy

The sustainable production of valuable minerals and metals from ore or metal-containing waste material is critical for a sustainable future. Extracting the metal values from natural ores bodies and complex engineered wastes requires various treatment processes. The group undertakes research into the fundamentals and application of such treatment processes. Key challenges include the changing characteristics of raw materials due to depletion of easy-to-process ore bodies, dealing with complex metal structures and associations in engineered wastes, and ensuring that new and existing extraction processes minimise energy and water use.

Separations Technology

The Separations Technology research group focuses on understanding the fundamentals and thermodynamics of separation processes involving hydrocarbons and other chemicals. Typical processes include distillation, liquid-liquid extraction, adsorption, supercritical fluid fractionation and membrane separation. Much of the work focuses on separating compounds where the underlying systems may exhibit azeotropy and association due to hydrogen bonding and where the systems may involve molecules with varying polarity and asymmetrical structure.

Bioresource Engineering

We can transition toward a more sustainable future by optimally using our available bioresources. This group focuses on developing industrial bioprocesses that are safe, sustainable and profitable, either by employing biological resources (e.g. live organisms or active biological molecules) to transform raw materials into valuable products, or by using biological raw materials as inputs into processes. A robust interdisciplinary approach leads to frequent collaboration with other disciplines at Stellenbosch University and leading international institutions.

Water Technology

The group focuses on research and development to address local and international challenges in water provision by improving existing water treatment technologies and developing new technologies. The group's strengths include membrane technology (microfiltration, ultrafiltration, reverse osmosis, forward osmosis, membrane distillation and Donnan dialysis) and technologies suitable for developing economies. Current projects range from investigation and modelling of basic phenomena to technology development leading to implementation in the field.

Process Monitoring and Machine Learning

Advances in online monitoring and data collection present an opportunity to enhance chemical engineering processes' efficiency, sustainability, and profitability. This group's expertise rests in applying machine learning techniques to improve the operation and control of chemical plants, emphasising industry-ready solutions. Applications include fault detection and diagnosis, causality analysis, operational state identification and actionable advisories.

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EXTRACTIVE METALLURGY:
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2024–2025 Engineering **Student Council**

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Chair

Kael Mostert
Vice-Chair

Nollen Bude
Secretary

Ailistiar Nyamafukudze
International Students

Angela Wang
Engineering Ball

Brock van der Westhuizen
First-Year Mentor and Mental Health

Carla Schultz
Marketing and Merchandise

Emilio Botes
Social Impact

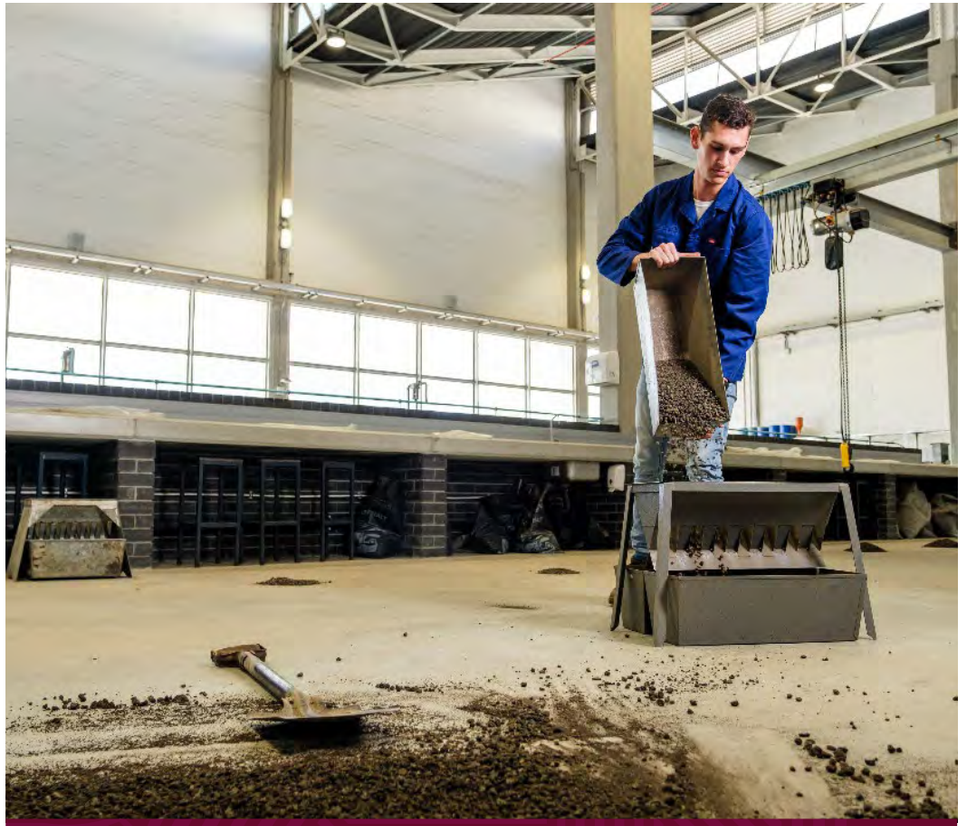
Francois Cameron Kotze
Treasurer

Johan Cloete
Industrial Liaison

Malven Kudzai Rufai
Sustainability

Nondumiso Mdabe
First-Year Mentor and Transformation

Shitshembiso Rikhotso
Events Coordinator



DEPARTMENT OF **CIVIL ENGINEERING**

The fast-changing civil engineering industry worldwide demands engineers who can devise original solutions to keep pace with new technology and evolving requirements. The Department of Civil Engineering produces graduates capable of meeting these challenges by keeping its academic offering relevant to present-day needs. Therefore, research forms a crucial part of the Department's activities, leveraging our newly refurbished state-of-the-art laboratory facilities to develop innovative solutions. In the image above, a student is using the riffle splitter on reclaimed asphalt pavement material for laboratory testing, evaluating its suitability for bitumen-stabilised material mixes.

First MEng (Civil) programme specialising in **Fire Engineering**

For the first time in Africa and the developing world, a university is offering a postgraduate engineering qualification that creates a new breed of engineers with specialist knowledge and skills in Fire Engineering. Through the application of science and engineering principles, fire engineers can identify risks related to fire, determine ways to reduce the risks and design ways for safeguarding against the wrath of fire. At the forefront of this initiative is a team of academics including Prof Richard Walls, Dr Natalia Flores Quiroz and Dr Courtney Devine.

What elevates the MEng programme with specialisation in Fire Engineering is the team's partnership with Ignis Fire Testing, a premier fire testing facility in South Africa known for its advanced technology and sustainable practices. This collaboration provides our students with invaluable hands-on experience and bridges the gap between academic theory and real-world application, preparing graduates for successful careers in fire engineering.

The Fire Engineering team worked closely with industry and the South African Institution of Civil Engineering, the South African Institution of Mechanical Engineers and the Society of Fire Protection Engineers South African Chapter to develop the curriculum.

Two programme options lead to a qualification in Fire Engineering: through coursework or by means of research. The hybrid coursework programme is offered online and takes two to three years to complete. Engineers from all the engineering disciplines, including fire protection and fire safety engineers who wish to enhance their specialised knowledge to the master's level, are eligible. For our first intake, 24 students registered for the coursework programme and six for the research programme, hailing from South Africa, Namibia, Zimbabwe and the United Kingdom.

The Department and Ignis Fire Testing are committed to promoting green practices and minimising the environmental impact of fire safety measures. This shared vision aligns with broader sustainable development goals and highlights the role of fire engineering in creating a safer and more sustainable future.

Partnerships and new data sources boost **mobility research**

Founded in 2014 by Prof Johann Andersen and Dr Megan Bruwer, the Stellenbosch Smart Mobility Lab (SSML) focuses on developing intelligent transport systems for Africa. The lab creates a data-rich environment for Big Data research and collaborates with industry partners to gather traffic data using drones, GPS and CCTV for traffic engineering applications locally and nationally.

Dr Elaine Goosen

The SSML partnered with Stellenbosch Local Municipality, PTV and Syntell to improve mobility in Stellenbosch by collecting real-time traffic data from CCTV cameras at intersections along the R44. This data is used to optimise traffic signal timings, reducing travel times. Following a successful 2020 pilot, SSML students are updating the transport demand model for use with PTV software, supporting further optimisation phases.

In collaboration with engineers from Innovative Transport Solutions (ITS), SSML postdoctoral researcher Dr Jared Arries and student Inge van Tonder participated in the national roundabout research project commissioned by SANRAL. The team employed drone footage and DataFromSky video processing software to collect vehicle trajectory data at more than 100 roundabouts throughout South Africa. This information, combined with GPS-sourced speed and trajectory data, was used to analyse traffic capacity and safety at roundabouts, as well as to review the applicability of standard geometric roadway design methods. The outcomes of this research informed national studies aimed at understanding roundabout operations and developing geometric design procedures intended to improve road safety at roundabouts.

A research partnership with TomTom gave SSML access to floating car data from GPS devices and smartphones. Dr Bruwer found this underused data can help identify pothole locations on rural South African roads. Future research may enhance navigation and pavement management systems using this approach.

Innovative project launches **international research network**

What if two undaunted engineers on opposite sides of the earth can give hope and economic opportunities to people living in abject poverty? Dr Elaine Goosen-Bicknell, a lecturer and researcher of the Pavement Engineering Group at the Department of Civil Engineering, and Dr Anand Sreeram, an assistant professor at the Nottingham Transportation Engineering Centre (NTEC), University of Nottingham in the UK, are planning an ambitious project that could impact up to 84% of South Africa's road network through sustainable infrastructure solutions, throwing a lifeline to struggling rural communities.

The project, Sustainable Road Construction to Aid Mobility and Inclusive Rural Economies in Developing Nations, directly addresses UN Sustainable Development Goals by targeting rural communities, which comprise 80% of the global population living in poverty. In South Africa, nearly one-third of the population resides in rural areas, with 26% living more than 2 kilometres from all-season roads.

The project is made possible by an International Collaboration Award through the Royal Society's International Partnerships Fund. The Award provides funding for three years (UK: £132,484; South Africa: £92,147) to enable outstanding emerging research leaders in the UK to develop research collaborations with international partners. The grants are open to newly independent researchers building their own group, who are ready to lead and drive the research vision of an international research programme.

This transformative research initiative develops circular road material technology specifically tailored for rural applications in developing nations. The project addresses critical infrastructure challenges by utilising waste materials as primary resources in road construction, while employing digitalisation tools to enhance rural accessibility and stimulate economic development.

The Award represents a significant achievement in securing international funding for sustainable infrastructure research, which has direct socio-economic benefits for developing nations by creating employment opportunities and small business ventures in rural areas.

The Smart Mobility Lab's Traffic Control Room where students monitor real-time traffic data along our national routes.

Upgrade offers safer laboratories and superior control

Following the general refurbishment of offices and study spaces in late 2022, the Department of Civil Engineering completed the refurbishment of its laboratories in 2024. This phase of upgrades, which began in 2023, focused primarily on improving safety measures and modernising critical infrastructure across all existing laboratory spaces. Key upgrades included the replacement and modernisation of distribution boards to ensure compliance with the latest electrical regulations, as well as a comprehensive upgrade of the fire alarm system throughout all laboratory areas.

The Department now boasts a designated Analytical Lab. This new, cleaner and more controlled environment enhances the ability to conduct high-precision research and supports improved workflow for analytical processes.

One of the most significant developments was in the Water Laboratory — currently the largest of its kind in South Africa by square metres. Here, the long-standing analogue control system, in use for over four decades, was replaced with a fully digitised control room, which greatly enhanced monitoring and data collection capabilities.

The Department introduced a dedicated Concrete Cutting Room to improve the health and safety of our staff and students by containing dust, noise and particles through proper ventilation and extraction systems. The room provides a controlled environment for heavy-duty equipment, reduces disruption to adjacent labs by isolating noise and vibration, and helps maintain clean workspaces by containing cutting-related debris. The facility also complies with industry safety standards, supporting best practices.

In the Structures Laboratory, a new dedicated storage room was established, and upgrades were made to the doors and glass in the concrete temperature room used for curing. Additional external improvements included the construction of a gated gas container storage area and the upgrade of the aggregate storage bays, which now feature improved partitioning and organisation.

The continuous investment in state-of-the-art infrastructure ensures that the Department can maintain its reputation for excellence, support the evolving needs of its programmes, and ultimately contribute to advancements in the field. As the Department looks ahead, it is excited about the potential for new discoveries and the opportunity to train the next generation of engineers in world-class facilities.

The Water Laboratory's fully digitised control room greatly enhances our monitoring and data collection capabilities.

The new Concrete Cutting Room's ventilation and extraction systems contain dust and noise.

Research **Output**

52	6	9	41
Subsidised Journal Articles	International Proceedings	Doctorates	Master's Degrees

Research **Themes**

Structural Engineering

We investigate smart and green construction materials, steel and concrete structures, structural reliability,fire engineering, built environment sustainability,and digital construction. Structural reliability covers the probabilistic load and resistance provisions for structural design. Fire engineering investigates structural performance during a fire. Built environment sustainability considers the durability of materials and structures, objective modelling and minimisation of environmental impact. Digital construction develops 3D printing equipment and materials while designing and testing printed structures.

Civil Engineering Informatics

This theme covers the needs of civil engineering practices in an information-driven environment. Applying information technology is concerned with intelligent modelling of the design process, the support systems for engineering management, and the technical aspects of urban engineering. We develop real-time data processing methods for decision-making and modelling complex engineering problems with inherent uncertainties.

Construction Engineering and Management

Research into construction management investigates the management and development of multi-disciplinary capital projects. It focuses on modular construction, construction risk, design management, constructability, sustainability and advanced technologies in construction.

Water and Environmental Engineering

Enabling stewardship of our natural resources while developing infrastructure for the functioning of our society is central to modern-day civil engineering. For instance, ensuring reliable and sustainable water supply to human settlements. Water resource development regards environmental requirements when designing large hydraulic structures such as dams, river abstraction works and bridges. A key concern is the medium-term effects of climate change on the continued design suitability of hydraulic and coastal structures.

Geotechnical Engineering

Large and impressive structures invariably require advanced support structures to ensure stability. We work on the challenges of problematic soils and mine tailings. Current research includes robust geotechnical analysis methods, designing high-specification structures on problem soils, and disposal method safety in mine tailings dams.

Pavement Engineering

This group is concerned with designing resilient, sustainable, and long-lasting roads for heavy traffic carried by our world-class network of national highways. Regarding materials science, the group evaluates the performance of secondary materials (crushed concrete, masonry, glass) for roads, accelerated testing of asphalt and environment-friendly bitumen stabilised materials, a performance-related seal design method for bitumen and modified binders, and a mix design and analysis system for asphalt bases.

Transportation Engineering

Road safety and intelligent transport systems (ITS) are top considerations in designing safe and efficient transportation systems. Our road safety research includes road crash causation, human factor influences, the role of geometric design, and public transport and pedestrian safety. Our ITS research covers public transport user information, multimodal database development, appropriate technology applications in developing countries and freeway management information applications for travel-time estimation and incident management systems. management information applications for travel-time estimation and incident management systems.

Chair

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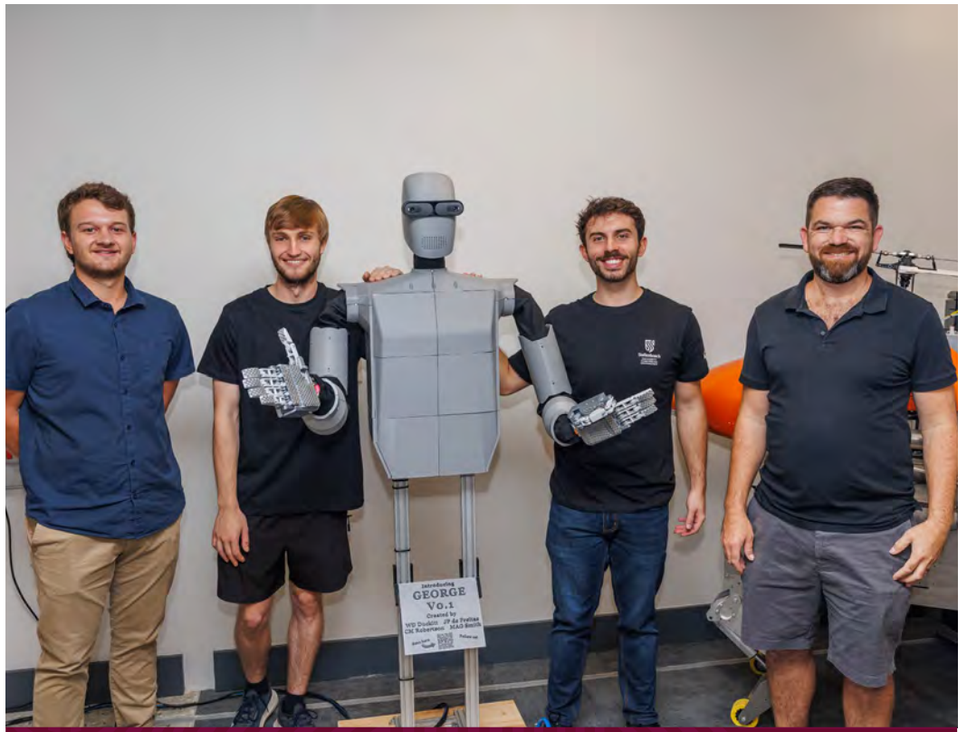

DEPARTMENT OF **ELECTRICAL AND ELECTRONIC ENGINEERING**

The completed upgrade to the Electrical and Electronic Engineering building has equipped the Department with state-of-the-art facilities that enable cutting-edge research and foster critical thinking and problem-solving skills. Faculty and students collaborate in diverse research groups to advance knowledge in the fields of energy, data engineering, informatics, robotics and telecommunications. Our new research platform in humanoid robotics has already proved itself irresistible to innovative minds across various engineering disciplines. Above, George V0.1, the first humanoid robot being built on the platform, shows off his moves. Encouraging him are his proud creators and role models (from the left) Mathias Smith, Connor Robertson, Pedro de Freitas and Dr William Duckitt.

Johan Fourie (left), Enaex Africa's innovation and market development executive, congratulates Prof Callen Fisher, appointed to the new Enaex Africa Research Chair in Mining Robotics.

E&E takes the lead in **mining safety**

The Department of Electrical and Electronic Engineering (E&E) made notable advancements in mining safety. Two new research chairs are set to promote interdisciplinary innovation for a safer and more efficient future in deep mining.

South Africa's mining industry, which has over 500 active mines, presents significant risks and challenges that require innovative and transformative solutions. In collaboration with Enaex Africa, the Department established the Enaex Africa Research Chair in Mining Robotics, appointing Dr Callen Fisher to enhance safety in mining with artificial intelligence (AI) and robotics while fostering local expertise. Dr Fisher emphasises the importance of upskilling students to drive innovation in the mining sector. The partnership focuses on safety, sustainability and efficiency, positioning both organisations at the forefront of research and development.

Tapping into the University's strategic initiative fund, the Department also established the Research Chair in Robotics, Process Control and Digitalisation, appointing Prof Lijun Zhang as its first incumbent. Prof Zhang's immediate objective is to develop collaborative projects within the Faculty of Engineering, working closely with local mining companies and research institutions, while also exploring partnerships with international firms and industry leaders. His long-term goal is to establish a prominent mining research centre in Africa that produces impactful publications, delivers practical engineering solutions, and provides excellent facilities for developing human capacity.

The development of autonomous robotic solutions for mining, alongside the establishment of global safety benchmarks, will reduce the dependency on human labour in hazardous environments while creating new job opportunities.

Humanoid robotics energises **futuristic research**

Recognising the future potential of humanoid robotics, the Department of Electrical and Electronic Engineering launched a cutting-edge research platform that showcases advanced robotics technology and demonstrates the power of interdisciplinary collaboration.

The platform already features a full-height humanoid robot with a functional torso and arms. Students engage in hands-on projects to create custom actuators, advanced robotic hands and humanoid arms. A master's student has worked on virtual robotics simulations using NVIDIA's IsaacSim to facilitate the transfer of knowledge from simulation to real-world applications. Built using the EtherCAT communication protocol, the robot is equipped with a webcam for vision tracking and can analyse and mimic human movements in real time. Dr William Duckitt, a lecturer in the Department, said the platform could be teleoperated remotely from anywhere in the world.

Professor honoured with IEEE fellowship

Celebrating his long and outstanding association with the IEEE, Prof Herman Kamper was recently recognised as an IEEE Fellow, Class of 2025, for his contributions to electrical machine design optimisation and application of synchronous machines. Prof Kamper is the sixth South African to receive this honour.

Since joining the Department as a senior lecturer in 1989, Prof Kamper has demonstrated his leadership in academic and research management. He advanced to associate professor in 2001, full professor in 2004, and was named distinguished professor in 2020, having also chaired the department from 2016 to 2018.

With a B2 rating from the National Research Foundation, Prof Kamper is an expert in designing and optimising electrical machines for emerging industries and renewable energy applications. He has published over 250 peer-reviewed articles, supervised and co-supervised 26 PhDs and co-authored one book.

Prof Kamper has earned several IEEE Best Paper awards and served as an associate editor for the *IEEE Transactions on Industry Applications* from 2014 to 2016. He has also served on the steering committee of the International Conference on Electrical Machines (ICEM).

Prof Coenrad Fourie

Superconductivity **research wins** the Van Duzer Prize

A paper by one of our research teams collaborating with six international teams won the 2023 Van Duzer Prize at the Applied Superconductivity Conference (ASC 2024) in the USA. The award-winning paper, "Results from the ColdFlux Superconductor Integrated Circuit Design Tool Project", was recognised as the most impactful paper published in the *IEEE Transactions on Applied Superconductivity* over the past year.

Prof Coenrad Fourie, a professor at the Department of Electrical and Electronic Engineering, served as the lead author. His research team included Dr Johannes Delport, Dr Kyle Jackman, and Dr Lieze Johnston, all alumni and currently research engineers at the Faculty of Engineering, as well as Tessa Hall, a junior lecturer pursuing her PhD in Electrical and Electronic Engineering.

The paper presented the results of a five-year project funded under the IARPA SuperTools programme, for which the teams, led by co-principal investigators Prof Coenrad Fourie and Prof Massoud Pedram at the University of Southern California, developed new methods and tools for superconductor integrated circuit design. Our international partners were research teams from the University of Southern California, the University of Florida and Northeastern University in the USA; Yokohama National University and Tokyo City University in Japan; and the University of Savoie Mont Blanc in France.

Co-author Prof Nobuyuki Yoshikawa from the Institute of Advanced Sciences at Yokohama National University accepted the award and the $1 000 cash prize on behalf of the teams and delivered a speech celebrating their collaborative efforts.

This recognition highlights the exceptional contributions of our researchers and graduates to the IARPA initiative, particularly within the ColdFlux project. Their innovative approach has distinguished them as rising leaders in the field of applied superconductivity.

Major renovations signal new **era for electrical and electronic engineering**

Extensive renovations to the Electrical and Electronic Engineering (E&E) building under the University's Campus Renewal Project have revitalised the Department's research programme by aligning its facilities with the cutting-edge research and high-quality education for which it is known.

Initially constructed in the 1970s, the building was fitted with UK Type G power outlets, based on the assumption that South Africa would adopt the British standard for square power outlets. However, South Africa opted for round power outlets (SA Type M), which are still in use today. One of the most appreciated aspects of the renovations was the elimination of the need for adapters to fit those square plugs!

The E&E building renovations were a complete rejuvenation. Prof Herman Engelbrecht, chair of the Department, explained: "A significant part of the refurbishment involved adding more staircases to ensure the building complies with current health and safety regulations."

The only areas that remained untouched were the previously refurbished undergraduate laboratories, the Electrical Machines Laboratory, the newly built Japie van Zyl area for final-years and the bathrooms.

The building's transformation includes several significant enhancements across its floors, designed to support the evolving needs of students and Faculty. Densification ensures space for additional lecture halls, meeting rooms and breakaway areas for collaborative work as well as quiet, focused tasks. Additionally, colourful wallpapers inspire creativity and bring vibrancy to the spaces.

Besides installing a new **Cryogenics Laboratory** for experiments with superconducting electronic circuits, all the laboratories underwent modernisation and enhancement. For instance, the **Power Electronics research area** gained a dedicated laboratory with heavy current (32A power sockets), a new transformer and a store for heavy machinery. The **Digital Signal Processing Laboratory (DSP)** was refurbished with a studio for audio recordings related to natural language processing research. The previously refurbished **Antenna and RF Electronics Laboratory** acquired a steel staircase for roof access and a small elevator for transporting large antennas.

The upgraded **Electronic Systems Laboratory (ESL)**, where South Africa's first satellite, SUNSAT, was designed and built, now features a workshop, an aeronautics laboratory, an environmental laboratory, shared offices, open-area seating for postgraduate students and two new lecture halls.

Beautifully refurbished and decorated spaces set the tone for innovation and discovery in the state-of-the-art facilities of the Electrical and Electronic Engineering building.

Research **Output**

60	67	20	45
Subsidised Journal Articles	International Proceedings	Doctorates	Master's Degrees

Research **Themes**

Robotics

In the Electronic Systems Laboratory (ESL), research, development and projects concentrate mainly on the control of autonomous vehicles and robots. The autonomous vehicles include satellites (e.g. CubeSats), manned and unmanned aerial vehicles (UAVs), autonomous underwater vehicles (AUVs), and unmanned ground vehicles (UGVs). The robots include two- and four-legged robots, hexapods, and humanoid robots. As most of the research is part of a larger system, students gain first-hand experience of the full breadth of the management and technical activities required in complex system development.

Electromagnetics

Current activities focus on the following projects: RF and microwave antennas for communications and radar systems, FEM, FDTD and MoM modelling of antennas and wave propagation in complex electromagnetic environments, development of numerical methods and software for simulation of electromagnetic fields, free-space and near-field measurement techniques, optimising complex antennas and microwave components, the Karoo Array Telescope (KAT) and the Square Kilometre Array (SKA). Other activities involve superconducting elements, nanosensors, electromagnetic compatibility, microwave filters and non-linear circuits. An antenna and microwave laboratory, supported by sophisticated instrumentation and powerful computing facilities, provides the infrastructure for research work.

Electrical Energy

This division covers research on electrical energy in terms of conversion, distribution, control and management, and renewable energy. Specifically, attention is given to multilevel power electronic converters, electrical machine design and drive systems, energy efficiency, and the measurement and management of electrical energy. Renewable energy focuses on photovoltaic solar energy, wind generator systems, system identification and grid integration. Our facilities include world-class laboratories and instrumentation for prototype testing and measurement. The Department has the only high-voltage laboratory in the Western Cape for advanced insulator tests and research.

Telecommunications and Informatics

This division works in a variety of areas that involve the manipulation of information-bearing signals. The work comprises the extraction and embedment of information in the signal (digital signal processing), the transmission of such signals over large distances (telecommunication) and through complex networks (communication networks), and automatic learning and the recognition of the signal content (machine learning and deep learning) with particular focus on speech and image signals, and specialised sensor signals.

Chair

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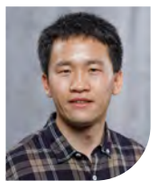

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DEPARTMENT OF **INDUSTRIAL ENGINEERING**

The rapid development of technologies enabling new ways of generating, processing and sharing information involving cyber-physical systems has placed us at the dawn of the fourth industrial revolution. The Department of Industrial Engineering produces a new breed of engineers equipped with computational skills and knowledge of the tools to help modern businesses adapt and stay competitive. They can provide solutions by creatively assessing the immediate situation, often by thinking outside the box. For example, in the image above, engineering researchers use machine learning to improve cyclists' power output by training algorithms to identify factors that influence power output maximally.


Profs Sara Grobbelaar and Stephen Matope

Industrial Engineering offers **opportunities for leadership**

The Department of Industrial Engineering is proud to offer numerous opportunities for leadership and growth.

We are excited to welcome two exceptional academics to our team. Prof Leila Goedhals-Gerber focuses on innovative solutions for complex supply systems, particularly in cold chain logistics. Her work aims to boost efficiency, sustainability and South Africa's competitiveness. Additionally, Dr Michelle Smit has joined the master's in Engineering Management (MEM) team, where she is eager to apply her expertise and support the programme's growth through collaborative research.

We are also pleased to announce the well-deserved promotions of two esteemed staff members. Prof Joubert van Eeden, chair of the Department of Industrial Engineering and associate professor in Supply Chain and Logistics Management, has been promoted to the prestigious position of full professor. Dr Philani Zincume, a dedicated lecturer in Engineering Management Practice, has also been recognised for his contributions and promoted to the role of senior lecturer.

Reaching a significant milestone in their academic careers, Prof Sara Grobbelaar and Prof Stephen Matope delivered inaugural lectures as full professors, introducing their research and new ideas to a diverse audience. Prof Grobbelaar, who is also a research associate at SU's CREST (Centre for Research on Evaluation, Science and Technology), presented a lecture on "Creating Our Shared Future: Innovation for Inclusive Development". Prof Stephen Matope's lecture was titled "Additive manufacturing: A game changer in advanced manufacturing engineering".

Our first MEM students **graduated!**

The Department of Industrial Engineering commemorated the first graduation ceremony for the inaugural cohort of the Master of Engineering in Engineering Management (MEM) degree in March 2024.

The flexible MEM programme represents a groundbreaking offering in engineering education. It is a part-time degree using hybrid online learning, meticulously crafted to equip engineers from various disciplines with additional leadership and management skills to thrive in their current roles and shape the future of their industries.

Launched in 2022, this three-year degree attracted over 80 students in its first year. The admission criteria are stringent, requiring candidates to hold a suitable science degree, have completed relevant work experience, and be employed full-time in a related field.

Remarkably, twelve of the first cohort had completed the rigorous curriculum, including eight modules and a comprehensive research assignment, in just two years — a testament to their dedication and commitment while balancing full-time employment. The breadth and depth of research undertaken by these pioneering graduates reflect the multifaceted nature of the MEM programme and its focus on cutting-edge knowledge and real-world applicability.

The proud MEM team eagerly anticipate the transformative impact that these graduates will undoubtedly have on the engineering landscape.

New master's programme elevates careers

In answer to the African economy's growing demand for logistics and supply chain expertise, the Department of Industrial Engineering launched a new postgraduate programme, the Master of Engineering in Logistics and Supply Chain Systems. These skills are essential for sustained economic development and job creation in the national trade and export markets. Prof Leila Goedhals-Gerber, programme manager, was delighted with the first intake of 31 students for 2025.

The logistics and supply chain systems specialisation equips students to develop forward-thinking strategies. Such strategies enhance the global competitiveness of supply chains by contributing to logistical frameworks and ensuring that these systems are resilient and future ready.

This structured, hybrid degree programme covers in-demand expertise across critical areas. Through a blend of theory, applied learning and industry-aligned modules, students gain the tools to design smarter, more resilient and sustainable supply chains.

Ideal for aspiring professionals and graduates worldwide, this online programme develops the strategic and technical capabilities needed to thrive in a rapidly evolving global landscape, shaping the future with their expertise, innovation and leadership.

Prof Leila Goedhals-Gerber with an illustration representing the global logistics and supply chain systems focus of the new MEng programme.

Bilateral **research for progress** gains momentum

Stellenbosch University and ETH Zurich are collaborating on two bilateral research projects funded by the Swiss Tropical Public Health Institute under their Leading House Africa grant scheme from 2023 to 2025. The research team includes Dr Andrew Earl, who is supervised by Prof Imke De Kock, a professor in Engineering Management and Sustainable Systems in the Department of Industrial Engineering, along with Dr Yael Borofsky, who is supervised by Professor David Kaufmann, both from ETH Zurich.

The first project focused on solar public lighting in informal settlements. It employed a co-design approach that involved residents, planners and makerspaces to develop lighting solutions tailored for Khayelitsha, a township in Cape Town. This initiative resulted in practical improvements and increased engagement from the local government.

Building on this success, a second project funded by the Swiss Network for International Studies is set to launch in 2025. It will examine how infrastructure technology pilots, such as solar lighting, can drive policy change. A Transdisciplinary Steering Committee, featuring members from major NGOs and international organisations, will guide this project.

In addition, Prof De Kock and Dr Earl are embarking on a new project in collaboration with Prof Floor van der Hilst at Utrecht University in the Netherlands. This project, sponsored by the National Research Foundation, will assess spatial inequality in water, energy and food security, as well as its implications for public health in rural areas. It will also examine how these factors will be impacted by climate change. The goal is to identify future-proof interventions that will enhance the resilience of vulnerable rural communities to health crises.

These projects aim to enhance living conditions in informal settlements in South Africa and beyond by means of collaborative, transdisciplinary methods that engage multiple stakeholders.

Electric retrofit transforms old diesel bus in landmark collaboration

Prof Sibusiso Moyo, Deputy Vice-Chancellor (Research, Innovation and Postgraduate Studies), and co-founder and CEO of Roam, Filip Lövström, in front of the converted bus and the electric bike that recently returned from a 6 000 km trip from Nairobi to Stellenbosch at SU's Electric Mobility Day.

A partnership between academic institutions, government agencies and industry led to the successful conversion of a 65-seater diesel bus into an electric vehicle. A perfect example of the circular economy in action, the project marks a significant step forward in South Africa's transition to sustainable transport and cleaner energy.

The project was initiated, funded and managed by the South African National Energy Development Institute (SANEDI) in partnership with Stellenbosch University (SU), Golden Arrow Bus Services, Rham Equipment, the Department of Science and Innovation, and the Department of Electricity and Energy (DEE). According to Professor Corne Schutte, Vice Dean of Research at the Faculty of Engineering, "This remarkable collaboration highlights the Faculty's commitment to fostering innovation through partnerships."

The 2005 diesel bus underwent a complete retrofit in which its diesel engine, gearbox and fuel tank were replaced with an electric motor, control electronics and high-capacity batteries. Despite the substantial mechanical overhaul, the bus achieved roadworthiness certification and retained the same weight as its original diesel version with an estimated range of 200 kilometres.

The converted bus was handed over to Golden Arrow Bus Services at the launch of SU's Electric Mobility Lab on the University's Electric Mobility Day as part of Transport Month in October. The prototype will undergo rigorous testing to evaluate its performance, energy consumption and reliability in real-world conditions with a view to its scalability for future applications in public transport.

"This conversion project is an important milestone in our efforts to promote cleaner, more sustainable public transport solutions," said Prof Thinus Booysen, founder of the Electric Mobility Lab at the Faculty of Engineering. "By converting existing diesel buses, we demonstrate how electric mobility can be integrated into South Africa's transport network without the need for entirely new vehicle fleets. It's a practical, cost-effective approach that also has significant environmental benefits."

As the testing phase continues, the consortium of partners remains committed to advancing South Africa's electric mobility sector and exploring new opportunities to modernise the country's public transport system.

Research **Output**

120	48	2	18	105
Subsidised Journal Articles	International & National Proceedings	Books Chapters	Doctorates	Master's Degrees

Research **Themes**

Engineering Management

Our research aims to improve value creation in technology-based enterprises by focussing on the following:

- *Enterprise Engineering*: Analysing enterprise design, implementation and operation to improve knowledge, innovation, financial and technology management.
- *Sustainable Systems:* Enabling the transition to sustainability by enhancing systems and technology evaluation, development, planning, design and management.
- *Health Systems Engineering*: Finding engineering solutions for challenges facing the healthcare sector.
- *Innovation for Inclusive Development*: Analysing, developing and evaluating inclusive innovations and systems.
- *Industrial Policy and Beneficiation*: Enabling mineral-rich countries to achieve sustainable development.
- *Innovation*: Management of technological innovation, innovation strategy, dynamics of technological change and the impact of emerging technologies..

Manufacturing

Our research covers the development of resource-efficient process chains for the sustainable and smart manufacturing of products through digital, economically-sound process chains that minimise negative environmental impacts while conserving energy and natural resources.

Additive and subtractive manufacturing; reverse engineering, materials design and development; prototyping, ergonomics (human factors); commercial readiness; micro-manufacturing; novel biocompatible alloy development.

Operations Management

Operations and supply chain management focus on process excellence within and between organisations in the following areas:

- *Asset Management:* Improving the coordinated activities of an organisation to realise value from assets.
- *Supply Chain Management:* Leveraging the impact of 4IR technologies to improve operations and supply chains through digitalisation.
- *Sustainable Freight Transport:* Facilitating decarbonisation of freight transport activities by focussing on modal shift and vehicle technology.
- *Logistics:* Ensuring the right product reaches the right place at the right time efficiently and cost-effectively.

Systems Modelling, Operations Research and Decision Support

This theme covers the development of mathematical models and their incorporation into computerised systems to support effective decisions in the industry. These models draw from applied mathematics, statistics, industrial engineering and computer science and apply to complex problems with many trade-off solutions. Examples include routing and scheduling decisions for delivery vehicle fleets, employee duty roster/timetabling construction, optimal production facility layout; simulation; spatio-temporal modelling using machine learning; and sentiment analysis.

Data Science

Research produces novel, efficient and robust data science technologies by developing machine learning and optimisation techniques. Data science techniques are applied to data sets to reveal patterns, trends and associations. Examples include:

- Forecasting customer demand from millions of retail transactions to understand demand patterns.
- Determining optimal segmentation of customers to customise service delivery and develop targeted marketing strategies.
- Using machine learning to predict order delivery times in a distribution scenario.
- Analysing imaging data for real-time inventory decision making.

Fourth Industrial Revolution and the Internet of Things

This theme focuses on automating industry and society using large-scale machine-to-machine communications, sensors, actuators, and other connected devices (the "Internet of Things"). Automatisation enables autonomous interaction between machines and humans. Examples include smart systems in transport and agriculture; intelligent management of energy and water in education and health sectors; real-time digital modelling of devices and industrial processes, using this "digital twin" for monitoring, diagnostics and prediction.

Chair

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DEPARTMENT OF MECHANICAL AND MECHATRONIC ENGINEERING

Providing quality engineering education in South Africa since 1944, the Department was the first to offer a degree programme in Mechatronics. This led to our name change to the Department of Mechanical and Mechatronic Engineering in 2006. Our newly refurbished research and teaching environment, featuring a dedicated Mechatronics Laboratory, offers top-notch facilities that equip graduates to tackle modern engineering challenges. In the image above, students from the Department demonstrate a final-year project that uses vibration patterns and sand to visualise wave behaviour during the annual Open Day.

Captivating moments from the SANAP relief voyage of 2023–2024.

Research endeavours of the **Sound and Vibration Research Group** in Antarctica

The South African National Antarctic Programme (SANAP) relief voyage of 2023–2024 was an extraordinary experience for four students from the Department of Mechanical and Mechatronic Engineering. Aboard the polar supply and research ship, SA Agulhas II, members of the Sound and Vibration Research Group, under the guidance of Prof Annie Bekker, participated in vital research while experiencing the wonders of Antarctica firsthand. They were Gerhard Durandt, Micaela Melim, Chanté van der Spuy and Yaxuan Zhu.

Adverse winds delayed departure for two days. The first leg from Cape Town to Marion Island tested the crew and students' resilience in navigating rough seas. At Penguin Bay, Antarctica, they assisted oceanography students from the University of Cape Town in data collection.

Arriving in Antarctica on 7 January, the crew hauled cargo to the SANAE base, facing stringent deadlines due to earlier setbacks. A highlight for the students was the trip to the base on snow tractors, covering 16 hours of snow-covered terrain.

This expedition marked a significant chapter in studying vibration and structural dynamics amid harsh conditions aboard the SA Agulhas II. The 134-metre icebreaker was designed in the Northern Hemisphere, but it is used mainly in the Southern Hemisphere, where it encounters less ice but heavier seas. Van der Spuy, a master's student in mechatronic engineering, explored shaft dynamics amidst ice impacts to gain insights into vessel resilience. She said, "The experience surpassed traditional classroom learning, providing an invaluable opportunity to apply theoretical knowledge in a real-world context."

Zhu, a PhD student from Aalto University, studied the structural response of the hull due to ice loading.

This voyage was the second expedition for team leader Durandt, a junior lecturer and PhD candidate in mechatronic engineering. He investigated the impact of high-frequency vibrations on the lifespan of the SA Agulhas II's hull. Durandt created a "structural digital twin" of the vessel, allowing him to study the impact of heavy waves in real-time.

Melim's research towards a master's in mechanical engineering, aimed at extending the functionality of the Mariner 4.0 app system developed by Dr Nicole Taylor during her doctoral research. The app collects almost real-time passenger data on motion sickness, correlating symptoms with ship motion to determine personal and group diagnostic thresholds. Melim is developing a predictive model by extending seakeeping analyses to incorporate weather conditions. Taking weather forecasts into consideration when planning voyages could improve the crew's well-being.

After a month in Antarctica, the ship returned to Cape Town on 20 February 2024. Reflecting on the journey, Melim praised Prof Bekker's mentorship, emphasising the invaluable research experience and personal growth it fostered. Prof Bekker's instrumental role in orchestrating the expedition highlighted the Faculty's dedication to enriching research experiences. Her leadership, combined with the students' commitment, not only propelled the voyage into a realm of scientific excellence but also of personal growth.

Extraordinary **collaboration** bridges knowledge and community

The South African Air Force (SAAF) Museum at Ysterplaat is one of Cape Town's hidden gems. In addition to being a popular tourist attraction, the museum plays a crucial role in fostering an interest in engineering among the city's youth.

Recently, the curator of the SAAF Museum, Lt-Col James du Toit, visited the Department of Mechanical and Mechatronic Engineering to discuss potential technical collaborations between the Department and the Museum. Given that aerospace engineering is a significant passion for our engineering students, the Department eagerly embraced the opportunity to enhance the technical content of the Museum's exhibitions.

In the coming years, the Department will promote involvement in the Museum through direct research and volunteer opportunities for its senior students. This initiative is just one of the many ways we can contribute to the community we serve.

Teaching excellence beyond the lecture hall

The Department of Mechanical and Mechatronic Engineering is committed to excellence and diversity in our teaching and research, extending that commitment beyond the traditional lecture hall. A recent collaboration with Automation Works and the Automation Works Training Facility exemplifies this dedication.

During the July recess, Prof Nawaz Mahomed and Mr Llewellyn Cupido partnered with the training facility to assist with Technobuzz, a three-day Winter School held in Swellendam. They introduced school learners to technology, many of whom experienced such opportunities for the first time.

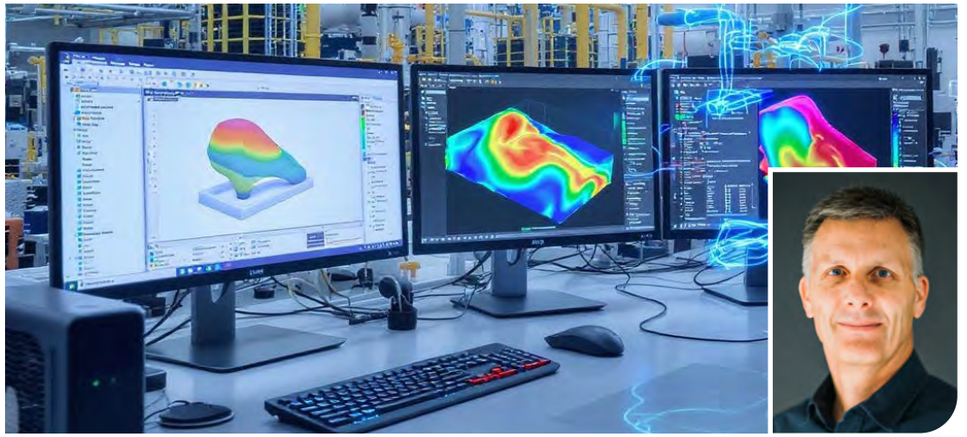
Prof Mahomed is an inspiring teacher who strives to connect with all students, regardless of their social backgrounds. He has been part of the Department since 2015, teaching machine design while conducting research on the solidification of metals, the atmospheric entry of space objects, and various applications in computational and experimental mechanics. Mr Cupido, a lecturer and doctoral candidate in the Department, focuses his research on materials engineering, specifically high-temperature exposure of high-alloy steels and phase-field modelling.

This year, the Department contributed to the Technobuzz programme by utilising desktop CNC milling machines. Learners were required to design a cutting tool path using algebra from their mathematics curriculum, program the CAM software with the necessary G-code and then test their coding on the milling machine to produce an actual machined part. Through these exercises, learners can see the relevance of their curriculum in real-world applications. For instance, they often struggle to connect their study of parabolas in mathematics with its application in a parabolic dish antenna!

The Department values industry collaborations because they help us maintain an inclusive and equitable learning environment where young people from all social identities can thrive.

Prof Nawaz Mahomed and Mr Llewellyn Cupido

New Chair in Thermofluid Systems Modelling kindles entrepreneurial spirit



Simulation software generates graphic representations of thermofluid systems. Prof Pieter Rousseau (insert) is the new incumbent of the Voigt Chair.

The Voigt Chair, a five-year, fully funded research position made possible by a bequest from Mr EEF Voigt, rotates among the Faculty of Engineering's departments. In 2024, it was awarded to the Department of Mechanical and Mechatronic Engineering as the Voigt Chair in Thermofluid Systems Modelling, becoming the Department's third research chair. Aiming to develop globally renowned expertise in cutting-edge thermofluid systems modelling, the Chair aligns with ongoing research in the Solar Thermal Energy Research Group and the Institute of Biomedical Engineering.

The Department appointed Prof Pieter Rousseau to the Voigt Chair. He brings a wealth of experience in thermofluid engineering, coupled with a strong entrepreneurial spirit, to the position. His passion for engineering began in childhood, when he helped his father in building and repairing items in their workshop. He pursued a BEng degree and specialised in thermofluid systems — essential for energy conversion processes, HVAC systems and biological systems.

While completing his master's and doctoral degrees part-time, Prof Rousseau lectured undergraduate courses in thermodynamics, fluid mechanics and HVAC at the University of Pretoria. At the same time, he started an engineering firm with a colleague where they developed simulation software for the thermal performance of buildings. He continued his academic journey as a professor at Northwest University in Potchefstroom, where he later also held the NRF SARChI Research Chair in Nuclear Engineering and served as Head of Department and Deputy Dean of Research.

Continuing with his entrepreneurial ventures, Prof Rousseau and another colleague founded MTech Industrial, an engineering firm that remains thriving today. The company spearheaded innovations such as the Flownex SE software suite and water heating heat pumps, widely adopted in South Africa and licensed to many top engineering companies in the USA, Europe and Asia.

His recent research integrates computational fluid dynamics and machine learning to enhance models for systems like supercritical carbon dioxide compressors and solar thermal cycles.

Highlighting the future of mechanical engineering, he emphasises the importance of thermofluid system modelling in advancing energy efficiency and healthcare technologies, blending academic knowledge and entrepreneurial spirit to tackle global challenges.

Research **Output**

115	47	10	46
Subsidised Journal Articles	International Proceedings	Doctorates	Master's Degrees (incl. 12 IBE)

Research **Themes**

Energy and the Environment

In close collaboration with the Centre for Renewable and Sustainable Energy Studies, the Department contributes to fundamental research into a wide range of energy generation technologies. Addressing transport needs, the group investigates the performance and impact of biofuels and blends in compression-ignition and spark-ignition engines. Finding uniquely South African solutions for concentrating solar thermal power and energy storage systems, the group's world-leading research in air-cooled heat exchangers and cooling towers is well known. Excellent experimental capabilities and strong computational expertise enable the group to develop custom-made fans, compressors and turbines for ocean current, wind, and solar energy exploitation, and air-cooled and hybrid (dry/wet) cooling systems. Research covering the energy-efficient design of ship propulsion, ship hulls and various turbomachinery is supported by the only 90 m long towing tank in southern Africa. The Department boasts the largest fan test facility (7 m diameter) in South Africa.

Mechanics and Dynamics

The group's activities consist of fundamental research on materials, the behaviour of structures and failure mechanisms and criteria. The materials research focuses on powder metal processing and products, material property extraction using digital image and volume correlation, characterisation of granular materials, and qualification of additive manufactured parts. The structures research looks for a fundamental understanding of the behaviour of structures under static and dynamic conditions and, in the case of vehicles, aircraft or ships, their impact on humans. Failure mechanisms and criteria cover composite materials and fracture and creep deformation of steels.

Mechatronics, Automation and Design

Diverse mechatronic systems such as reconfigurable manufacturing systems, machine vision applications, cyber-physical systems and digital twins, augmented/virtual reality and human-system integration. These systems are applied in diverse contexts, including manufacturing, mining, health care, renewable energy systems, motor vehicles production, facilities management and maintenance management.

Computational Modelling

The group's expertise in optimisation theory and algorithm development, finite element methods (FEM), computational fluid dynamics (CFD), discrete element methods (DEM) and continuum methods is world-renowned. The DEM work is applied to, among other things, mining and earthmoving equipment, particle dampers and conveyors. We often link optimisation methods with the FEM and CFD work in applications related to fluid-structure interaction, turbomachinery, combustion and various renewable energy technology applications. The group also has expertise in the modelling and simulation of metal casting processes, emphasising solidification analysis and segregation.

Biomedical Engineering

Technologies such as 3D printing, microcomputers and artificial intelligence are opening up new opportunities for engineering in the biomedical field. This group develops innovative minimally invasive devices to collect healthcare information, mechatronic devices for telemedicine, customised solutions for treating specific diseases, and develops and tests medical sensors for in vivo testing of the human knee's biomechanical properties.

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Outreach Programmes

Open Day

The annual online and on campus Open Day offers learners, parents, and the general public an exciting opportunity to explore engineering as a field of study and a career path. The Open Day highlights how engineers solve real-world challenges, drive innovation, and contribute to society. It offers a glimpse into the diverse career opportunities in engineering and how the field can shape a rewarding future.

Enquiries: Ms Tanya Ficker
+27 21 808 9403 | tanya@sun.ac.za

Women in Engineering

During the annual Women in Engineering afternoon, Grade 10 to 12 girls who excel in Mathematics and Physical Sciences are introduced to the possibilities of a career in engineering. The event features women engineers from various industries, along with lecturers and students, who share their insights and experiences.

Enquiries: Mr August Engelbrecht
+27 21 808 3947 | august@sun.ac.za

Engineering Winter Week

During the annual Winter Week, Grade 11 and 12 learners gain a comprehensive understanding of the engineering profession. This event includes presentations by lecturers and engineers, as well as visits to industries and laboratories, providing students with a clear picture of an engineer's work.

Enquiries: Ms Ainsley Truter
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Top Achiever Sessions

Top achievers in Grade 11 and 12, along with their parents, are invited to sessions held in Stellenbosch and major cities across South Africa and Namibia. These sessions provide information about engineering careers and the Faculty's degree programmes. Additionally, some departments conduct programme-specific webinars to further promote their engineering degrees and boost registrations.

Enquiries: Mr August Engelbrecht
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First Generation Experience

Universities can be pretty daunting if you have no experience in academic or tertiary institutions. In 2018 the Faculty launched this outreach for Grade 11 and 12 top achievers whose parents have not had the opportunity to attend university. During a day visit, they experience the exciting vibe of campus, learn about the Faculty's degree programmes and other SET fields of study and meet the Dean.

Enquiries: Mr August Engelbrecht
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Top achievers on a campus visit to learn more about engineering careers and study programmes.

On Open Day, engineering students spark captivated senior learners' interest in engineering by showing them how they solve real-world problems with technology and innovative thinking.

An outreach to increase the registration rate of black, African speaking students in South Africa

In October 2019, we launched an outreach project aimed at increasing the registration rates of black, African-speaking students in South Africa. The initiative targeted prospective students from nine vernacular language backgrounds (excluding English and Afrikaans) who received provisional offers to study engineering at Stellenbosch University. Senior Matie students from similar language backgrounds participated in the project, addressing the prospective students in their mother tongue. They shared their experiences as engineering students at Stellenbosch University and helped alleviate any fears and concerns.

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The Faculty marked its 80th year by gifting celebratory T-shirts to the staff.

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