



Excellence in engineering, the built environment and information technology

The Faculty of Engineering, Built Environment and Information Technology (EBIT) at the University of Pretoria is making a very significant contribution to expanding South Africa's skills base through the leading role it plays in teaching, research and community engagement. This success has been achieved through sustained and dedicated teamwork between the students and staff, and with the support and cooperation of its industry partners. Prof Roelf Sandenbergh, dean of the faculty since the turn of the century, has been privileged to guide the faculty in its quest for excellence and has recently been reappointed for a third term of office.



→ Prof Roelf Sandenbergh, dean of the Faculty of Engineering, Built Environment and Information Technology at the University of Pretoria.

This faculty was established in January 2001, following the University's restructuring of its academic offering. This process involved the amalgamation of the former Faculty of Engineering, the departments of Architecture, Construction Management, Quantity Surveying, Landscape Architecture and Town and Regional Planning (housed in the Faculty of Science), Informatics and Computer Science (housed in the Faculty of Economic and Management Sciences), as well as Information Science (housed in the Faculty of Humanities).

Over the past nine years, the faculty has grown as a fully integrated unit, and its teaching and research activities have expanded. A wide variety of programmes, ranging from electrical, electronic and computer engineering, computer science and informatics right through to the information sciences, is offered in a synergistic manner in one faculty.

The restructured faculty initially comprised three schools: Engineering, the Built Environment and Information Technology. In 2007, the Graduate School of Technology Management was established as a fourth school in

the faculty. Prof Calie Pistorius, the University's former Vice-Chancellor and Principal, was appointed as the first dean of the new faculty in 2001, with Prof Sandenbergh as the first chairperson of the School of Engineering.

Following the appointment of Prof Pistorius as Vice-Chancellor and Principal later that year, Prof Sandenbergh was appointed as dean for an initial term of four years. His reappointment for a second term in 2005 and a third in 2009 is testimony to the excellent performance of this faculty under his stewardship.

Prof Sandenbergh is a registered professional engineer and proud alumnus of the University of Pretoria. He graduated with a BEng (Chemical Engineering) in 1972, followed by an MEng (Metallurgical Engineering) in 1975. He obtained his doctorate in 1983. He is a fellow of the South African Academy of Engineering, member and chairperson of the Professional Advisory Committee on Metallurgical Engineering of the Engineering Council of South Africa (ECSA), member of the Academy of Science of South Africa, honorary life

fellow of the South African Institute of Mining and Metallurgy, and member and former president of the Corrosion Institute of Southern Africa. In addition to teaching, he contributes to the profession through research and consultation in the fields of extractive metallurgy and corrosion.

He started his career as technical assistant at the Hartbeestfontein Gold Mining Company before joining the University of Pretoria as a lecturer in Materials Science and Metallurgical Engineering in 1974. He was appointed head of department in 1996, chairperson of the School of Engineering in 2001 and dean later that year. As his position as dean coincides with the growth of the faculty itself, the achievements of the faculty since its establishment in 2001 under his tenure represent the highlights of his career.

The faculty is the largest of its kind in the country. Its student numbers have increased steadily since 2001, and currently stand at over 9 000, of which approximately a third comprises postgraduate students. The profile of the faculty has also undergone a transformation since the turn of the century. About 43% of its students are from the previously disadvantaged population groups, while just under a third of its students are female. The faculty is unique in its approach to and development of capabilities in innovation. Its qualifications are internationally accredited and cover a wide variety of specialist fields. Its teaching and research programmes are characterised by collaboration with international universities and are supported by the faculty's Institute for Technological Innovation and the Department of Engineering and

Technology Management – both the first and only ones of their kind in South Africa. The faculty offers unique training in the management of technology and has strong ties with industry. Specialists from industry also serve on a number of advisory boards that have been established in the faculty, which ensures that the programmes offered and research conducted are relevant to the market, while the experience gained by graduates can be applied in practice and meets industry requirements.

Teaching and learning

The School of Engineering is one of the largest of its kind in South Africa and produces by far the greatest number of graduates in the country. It comprises seven departments: Chemical Engineering, Civil



Engineering, Electrical, Electronic and Computer Engineering, Industrial and Systems Engineering, Materials Science and Metallurgical Engineering, Mechanical and Aeronautical Engineering, and Mining Engineering. Since 2000, it has engineered a strong growth in undergraduate student numbers with enrolments more than doubling (from 1 845 in 2000 to 3 999 in 2009). To accommodate further growth, significant support was obtained from government and the University Council to significantly expand the engineering school through the construction of additional lecture halls, as well as teaching and research laboratories.

The School for the Built Environment is also one of the largest of its kind in the country and covers the entire spectrum of programmes in the built environment. It comprises the departments of Architecture, Construction Economics, and Town and Regional Planning. Its programmes have all been redesigned to align them with international norms, and include professional qualifications in architecture, interior architecture and landscape architecture. All its programmes are internationally accredited, display a commitment to innovation, and strive to promote

the equitable and sustainable development of a prospering, rapidly urbanising South African society.

The School of Information Technology is the first of its kind in South Africa and students have the advantage of an integrated approach to IT. It comprises the departments of Computer Science, Informatics and Information Science. Close links exist with the Department of Electrical, Electronic and Computer Engineering in the School of Engineering. The integration of these three academic departments into one school has brought considerable advantages for the academic programmes that are offered. It has an excellent and modern infrastructure to support teaching, sophisticated undergraduate computer laboratories and specialised research facilities. This has contributed to the expansion of its programmes, which includes the introduction of a four-year degree in IT. This exciting programme is the first of its kind in South Africa and is the only degree programme to integrate all the IT-related disciplines.

The Graduate School of Technology Management presents postgraduate programmes in the Department of Engineering and Technology Management.

It also offers internationally recognised management development programmes that address different needs in the fields of technology management, engineering management and project management. The aim of its programmes is to provide graduates with skills and knowledge on the management of engineering processes, systems and services. A strong focus on research ensures relevance to the market in terms of increased competitiveness, optimising product life cycles and technology transfer, and positioning technological abilities in the international context. Some of the programmes are accredited with the Project Management Institute (PMI) in the USA and the International Association for the Management of Technology (IAMOT).



Community engagement

A milestone for the faculty was the establishment of the Community-based Project Module (JCP) in February 2005 as a compulsory module for all undergraduate programmes in the faculty. Students receive training in community engagement protocols and have to conceive and execute a community-based project that involves working at least 40 hours in a community and then reflecting on their experiences through web-based systems and presenting their projects to their peers and the programme leader.

They complete projects that are aimed at achieving a beneficial impact on a chosen section of society by engaging with a community that is different from their own social background. In the

process, they develop an awareness of personal, social and cultural values, an attitude to be of service and a deep understanding of social issues, while developing important multidisciplinary life skills, such as communication, interpersonal and leadership skills. Over the past three years, students have undertaken an average of more than 400 community engagement projects annually.

Research

Research forms an integral part of the activities of the faculty. It not only provides a sound basis for the faculty's teaching programmes, but also contributes to the acquisition and application of knowledge across the spectrum of disciplines covered in the faculty. Research contributions in the form of articles published in

accredited journals, research reports and conference contributions have increased significantly over the last decade, thanks to contributions by researchers across the faculty.

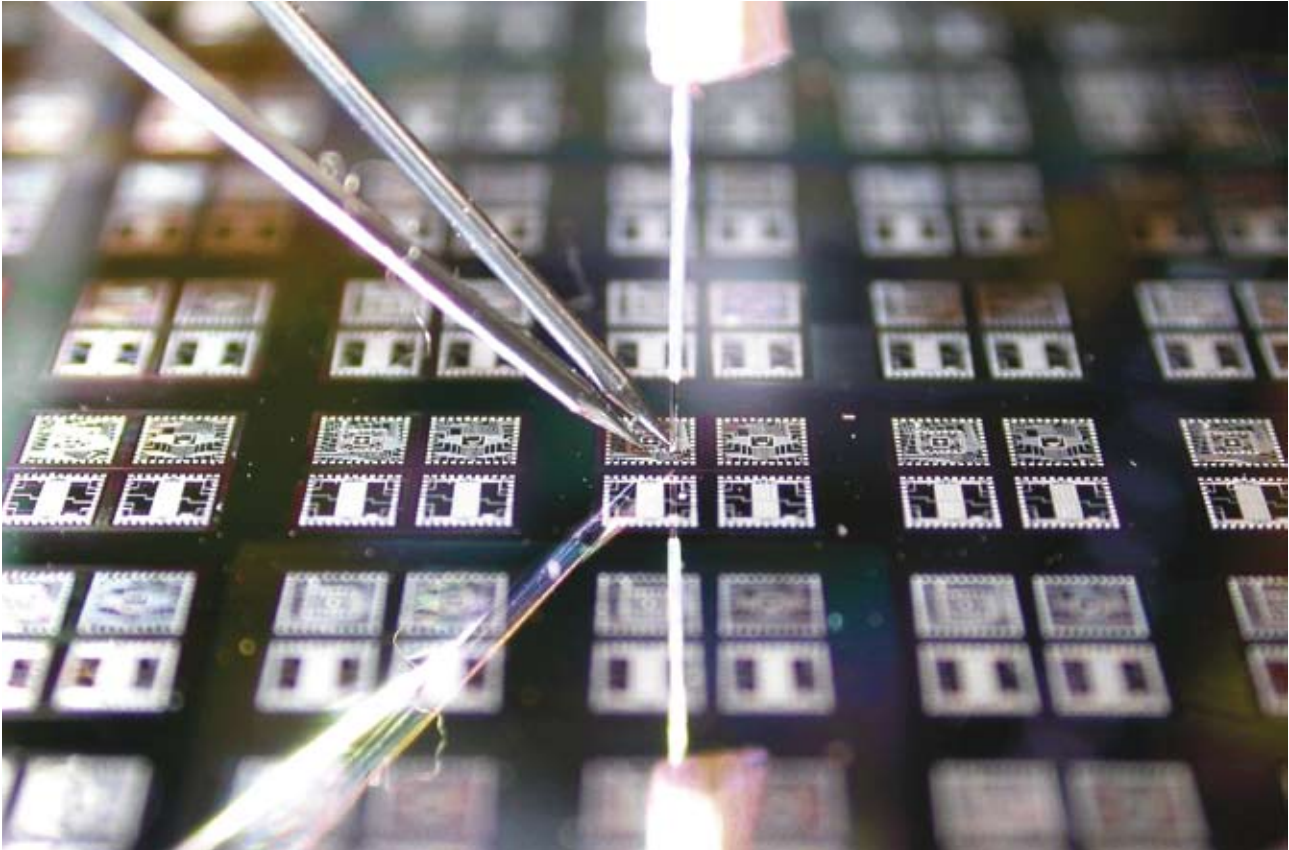
The quest is to improve on both the participation of staff, and the number and quality of research outputs in the future. The number of researchers rated by the National Research Foundation (NRF) has also increased significantly.

A number of research focus areas have been developed, which include the following:

- Environment and cultural landscapes, urban environments and housing, and baseline indicators for the South African built environment (Built Environment)

→ *The School for the Built Environment is one of the largest of its kind in the country and includes professional qualifications in architecture, interior architecture and landscape architecture.*





→ Research into injection-enhanced silicon in avalanche (INSiAVA) technology is being conducted in the Carl and Emily Fuchs Institute for Microelectronics (CEFIM) in the Department of Electrical, Electronic and Computer Engineering.

- Control engineering, fluoro-material and process integration, nanotechnology, process integration and optimisation, reaction and environmental engineering, and carbon materials (Chemical Engineering)
- Concrete technology, railway engineering, transport engineering, geo-engineering, water engineering and structural design (Civil Engineering)
- Robotics, high-performance computing, software engineering, artificial intelligence, health informatics, computer and information security (Computer Engineering)
- Green building initiatives (Construction Economics)
- Photonic integrated circuits, broadband wireless communication, antenna design

and development, bio-engineering, demand-side management and energy efficiency (Electrical, Electronic and Computer Engineering)

- Transport optimisation, reliability engineering and business process optimisation (Industrial and Systems Engineering)
- Indigenous knowledge, publishing and knowledge management (Information Science)
- Scientometrics (Institute for Technological Innovation)
- Thermoflow, vibration monitoring, damage detection, maintenance engineering, automotive engineering, and mining machinery and materials (Mechanical and Aeronautical Engineering)
- Minerals processing, pyrometallurgy, hydrometallurgy, physical metallurgy, welding

engineering and industry support and development (Materials Science and Metallurgical Engineering)

- Mine design, safety and risk management and rock engineering (Mining Engineering)
- Development planning (Town and Regional Planning)

The consolidation of research activities is encouraged and several sustainable research groups have been formed to make an impact both locally and internationally. Several departments are developing technologies related to the pebble bed modular reactor (PBMR). The further development, application and commercialisation of research are priorities for the faculty. Good progress has been made with the further development of silicon-



→ *Research focus areas in the Department of Chemical Engineering include control engineering, fluoro-material and process integration, nanotechnology, process integration and optimisation, reactor and environmental engineering.*



based light-emitting devices with the potential to enhance the speed of electronic devices by using light for on-chip communication. Progress has also been made with the avalanche approach to increase the efficiency of the devices, and with securing venture funding to further support the project.

Furthermore, the faculty is developing and commercialising software applications at the Coach Lab (at the Innovation Hub), with the support of industry.

Industry collaboration

The faculty enjoys the support of industry partners. Sponsored

chairs are an indication of industry's confidence in the development, application and commercialisation of research in the faculty, and the impact of its continuous innovation in its response to the scientific, technological and industrial needs of the country. This enhances the faculty's potential to increase its research outputs. Recent highlights include the following:

- ▣ **Chair in Maintenance Engineering.** This is jointly located in the Department of Mechanical and Aeronautical Engineering and the Graduate School of Technology Management. It is sponsored by a number of industry partners,

including Sasol, Eskom, Exxaro and Anglo American.

- ▣ **Anglo American Chair in Pyrometallurgy.** This is housed in the Department of Materials Science and Metallurgical Engineering.
- ▣ **DST Chair in Fluoro-material Science and Process Integration.** This chair of the Department of Science and Technology (DST) is in the Department of Chemical Engineering.
- ▣ **DST Chair in Artificial Intelligence.** This chair in the Department of Computer Science is making significant international contributions in the field of computational intelligence.

- o **DST Chair in Carbon Technology and Materials.** This chair in the Institute of Applied Materials is a joint activity with the Faculty of Natural and Agricultural Sciences. It is aimed at developing high-level human resources and carbon materials for the nuclear industry.
- o **Sentech Chair in Broadband Multimedia Communications.** This is based in the Department of Electrical, Electronic and Computer Engineering.
- o **Hub for Energy Efficiency and Demand-side Management.** This is based in the Department of Electrical, Electronic and Computer Engineering and was made possible through the support of the South African National Energy Research Institute (SANERI). It aims to strengthen energy-related research, human capacity development, and market transformation as well as enterprise development initiatives.
- o **Advanced Engineering Centre of Excellence.** This is based in the Department of Mechanical and Aeronautical Engineering and was established with the support of the

Department of Trade and Industry. It offers unique opportunities for research and human capital development initiatives in support of local advanced manufacturing industries. Three programmes have been implemented: Advanced Materials, Manufacturing, and Mining Machinery.

- o **Industrial Metals and Minerals Research Institute.** This is based in the Department of Materials Science and Metallurgical Engineering and was established with the support of Arcelor-Mittal (previously Iscor).
- o **Centre for Telecommunications Engineering for the Information Society.** Several industry partners support this centre, including Telkom, Unisys, EMC and Alvarion. Its research focus areas include distributed system security, wireless sensor networks, long-term evolution (LTE) and WiMAX.
- o **Carl and Emily Fuchs Institute for Microelectronics (CEFIM).** CEFIM has been active in the field of microelectronics research and specialist training for the last 27 years. The research and

postgraduate programme is mainly in the field of integrated circuit design, especially the design of analogue signal processors, RF circuits and optical receivers in CMOS technology.

- o **GijimaAST Informatics Centre.** The centre is housed in the Department of Informatics at the School of Information Technology, and aims to support electronic meetings and the evaluation of software usability. The facility is equipped with the latest software and networked computers, recording equipment and a separate observers' room.
- o **Research into reaction engineering, tribology and environmental engineering.** Research in these fields has been made possible with the support of Sasol, Eskom, Arcelor-Mittal and the Anglo American Corporation. The current focus in reaction engineering is on reactor hydrodynamics, with specific reference to trickle flow and gas-solid fluidisation. The main activity of the tribology laboratory is to assist in the evaluation and selection of lubricants. Environmental engineering research focuses on water utilisation. Sastech and the East Rand Water Care Company (ERWAT) are the sponsors.
- o **Chair in Railway Engineering.** This chair in the Department of Civil Engineering is supported by Transnet Freight Rail (previously Spoornet). It is responsible for railway research and is currently carrying out research projects for Transnet and other industry partners. It focuses on the development of innovative track systems and components, as well as inspection tools and systems to enhance track and vehicle maintenance. It also presents short courses in aspects of railway engineering, ranging from maintenance to infrastructure management and rolling stock.



→ Research focus areas in the Department of Mechanical and Aeronautical Engineering include thermoflow, vibration monitoring and automotive engineering.



Challenges

One of the greatest challenges for the faculty is to address the country's mounting demand for scarce skills. The new engineering facilities currently under construction will enable the further expansion of the School of Engineering and provide better support for the teaching and learning activities of the faculty in

the form of additional lecture halls, teaching and research laboratories, groupwork facilities and improved access for disabled students.

The faculty will continue to strive to provide excellent education in all its disciplines by optimising the use of its limited resources, to improve the throughput rate, and to overcome the challenges posed by

the changes in the secondary school curricula. Academic support in the form of extended study programmes to create an alternative access route for students who show the necessary academic potential, and to assist them in completing their studies successfully, is available in engineering and information technology.

The existing extended degree programmes in engineering is being expanded in 2010 with the introduction of the Engineering Augmented Degree Programme (ENGAGE), in which students will be supported through augmented modules in parallel with the mainstream modules.

Future plans include expanding the faculty's research footprint by increasing the number of full-time postgraduate students, increasing the industry sponsorship of students, facilities and staff, and increasing both the number and quality of research outputs. By increasing its internationalisation activities and the accreditation of programmes, the faculty will be able to achieve greater visibility and influence. As such, it will contribute to the University's overall mission of being a leader in higher education that is recognised internationally for academic excellence and a focus on quality: a university that is known for its international competitiveness and local relevance through continuous innovation.

The significant progress the faculty has made in the fields of teaching, research and community engagement over the past nine years provides a steady platform for sustained growth into the future. ➦