



Department of **Electrical and Electronic Engineering** at the University of Johannesburg (UJ)

BACKGROUND

Previously known as the Rand Afrikaans University (RAU)- a prominent South African institution of higher education and research that existed between 1967 and 2004; the University of Johannesburg – now colloquially known as UJ, came into existence in 2005 as a result of RAU merging with the Technikon Witwatersrand (TWR) and the Soweto and East Rand campuses of Vista University.

The school originally came into existence in 1981 as a faculty under the RAU banner. The Department of Electrical and Electronic Engineering Science, as well as the Department of Electrical and Electronic Engineering Technology are now the School of Electrical Engineering and fall under UJ's Faculty of Engineering and the Built Environment (FEBE).

FEBE is the first faculty in South Africa to offer global education to the widest range of comprehensive accredited professional engineering, engineering technology and built environment qualifications.



The Faculty of Engineering and the Built Environment (FEBE) is 1 of 7 faculties of University of Johannesburg, with 13 departments under five Schools.

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TEACHING AND RESEARCH EXCELLENCE

In keeping with the University's quest for global excellence and stature, the school of Electrical Engineering, just like the faculty it falls under, is innovative in its approach to teaching, learning, collaborative research, community engagement, international partnerships and remains at the cutting edge of technology.

Its unique proposition is that it is a platform for connecting students, academia and communities through engineering research and innovation with the help of partner brands – ultimately empowering society and the world through knowledge and upliftment.

The school is actively engaged in outreach initiatives and the shaping of graduates who possess the ability to solve complex engineering problems. It also features robust research and innovation development in its hi-tech laboratories. Focus areas include telecommunications, control and instrumentation, electrical energy and information engineering.

The department of Electrical and Electronic Engineering Science – located at UJ's Auckland Park campus is concerned with qualifications pertaining to the use of electricity to transmit energy or information; while the department of Electrical and Electronic Engineering Technology- located at the Doornfontein campus, specialises in electrical engineering technology programmes.



VILLAGE 4.0

Devoid of basic services such as electricity, running water and roads, Gwawkwani had little to no access, infrastructure, development and public services. The remote village was a technologically uncultivated and digitally inhospitable land, inhabited by 70 – 100 people. In March 2013, UJ's Department of Electrical and Electronic Engineering Science, partnered with key role players in the South African industry on a project to create a sustainable digital village by giving the villagers access to basic services and stimulating socio-economic development activities through sustainable interventions which include the following:



Solar lights and charging stations

The department fitted each of the 35 households with solar powered lights and charging stations as well as solar powered streetlights to light the dark access roads of the village at night. This initiative enabled the villagers – who had never had electricity, to have much more than kerosene and candlelight and stopped them from having to walk to neighbouring villages to charge their mobile phones.



Solar powered water pumps and geysers

Before the department installed the solar powered, high-quality water system, the village relied on an old diesel pump and the malaria proclaimed Mutale river for water. The destitute villagers

had to contribute money each month to buy diesel for the pump and survived on a little over 5 litres of water per household each day. The solar powered pump delivers between 3000 to 5000 litres a day- supplying the village with clean, unlimited and uninterrupted water at various points with taps and solar geysers across the village.



A commercial grade photovoltaic solar bakery

Conceptualised by UJ's Profs Johan Meyer and Sune von Solms, the Solar Bread Box is a first for commercial sized PV solar bakeries. Boasting the same equipment and baking cycle as a standard grid tied commercial bakery, the Solar Bread Box functions on the conversion of solar energy as much as possible – minimising the cost of solar energy storage solutions.

The department partnered with Schneider Electric and the Bakery and Food Technology Incubator of South Africa (BICSA), to build the bakery and trained individuals on how to bake, run a bakery as a business as well as how to maintain the solar PV system. The bakery has sparked economic activity, created jobs, fostered an enterprise that now serves neighbouring villages with access to wholesome foods, with the production of at least 100 loaves of bread every day.



Cold storage room

With daytime temperatures soaring up to 40 °C and the villagers not having refrigerators to store perishables and anything cold to drink, the department transformed a shipping container into a solar powered cold room.



Network

Having installed the first Internet of Things, (IoT) network connection in Gwakwani in 2018, the department can now remotely obtain real-time data for monitoring all the systems installed in the village ensuring that they are functioning at their best as well as using the collected data from the state of the art Sigfox Base station and IoT network, for social and industrial research purposes.



THE SHELL ECO-MARATHON

The Shell Eco-Marathon (SEM) is a unique global programme for science, technology, engineering and maths students to design and build ultra-energy-efficient cars. The purpose of the competition is to determine which team designed and built the most energy-efficient vehicle. The winners are the teams who go further on the least amount of energy on the track.

UJ partnered with Shell and began hosting the African segment of the international competition in 2014 in order to provide an international platform where engineers in the making can showcase their ability to think innovatively and build something with their hands while competing with one another on the very important platform of engineering.

The Shell Eco-Marathon is important and necessary because gives participants an opportunity to exploit and control technology – preparing them to solve energy efficiency and pollution challenges while inspiring them to become leading engineers of the future by turning their visions of more sustainable transport into reality.

In 2016, the UJ Voltronics team finished in 15th place at the Shell Eco-Marathon Europe, which was held in London. The team’s prototype battery-electrical vehicle finished ahead of teams from France, the Netherlands, Ireland, Turkey and Spain. At the 2019 event in South Africa, another team under the name of Floriders achieved a new South African record of 564 km/kWh in the battery electric prototype class.



TELKOM CENTRE OF EXCELLENCE

Since its inception, the Telkom Centre of Excellence- developed within the department of Electrical and Electronic Engineering Science, has established itself a local hub of expertise, and is shaping the landscape of optical engineering, communications and information processing in South Africa. The centre is the first, and still the only manufacturer of fibre Bragg gratings in optical fibre in South Africa for application in fibre optic sensors and optical communication systems. At the moment the centre's focus is on laser sources for communication as well as optical fibre sensors for monitoring civil structures.

Boasting one of the best equipped photonics laboratories in Africa, the centre is the only engineering faculty in South Africa that is focused on the real-world application of photonics – giving students the opportunity to apply the science. Projects range from designing and manufacturing fibre laser sources for communication for the telecommunication giant Telkom, to sensor application for civil structures.

The focus on fibre lasers stems from the communication work the centre does. Through research, the centre has found fibre lasers easier to adapt than semi-conductor sources and that by using optical fibre components, they can manufacture smaller, lighter and cheaper lasers that can easily be reconfigured for different communication purposes.

For the civil engineering field, the centre conceptualises, manufactures, installs and monitors optical fibre sensors in structural elements to monitor temperature and strain for maintenance programs and serviceability of these engineering structures. There is also work done in maturity determination of newly placed concrete.

Going forward, the centre is exploring chemical and biochemical sensing – especially for water quality monitoring with the use of optical fibre sensors in addition to developing sinkhole monitoring technology.

FRENCH SOUTH AFRICAN SCHNEIDER ELECTRIC EDUCATION CENTRE (F'SASEC)

This department is responsible for delivering engineering technologists capable of applying, designing or developing components and systems based on existing cutting-edge technologies. In this respect, the department refurbished its electric machine's lab in 2014, replacing the old equipment with new – more modern and technologically advanced machines.

In 2016, the University partnered with Schneider-Electric Foundation and the French Ministry of Education in order to establish the French South African Schneider Electric Education Centre (F'SASEC) in the department.

The primary focus of the centre is to promote access to energy in disadvantaged communities for sustainable development. The Schneider Laboratory, thus acquired, has been equipped with state of art working benches or panels that make use of renewable energy generation sources and energy utilisation.

One of the department's highlights is a student's PhD study which is focused on developing suitable architecture of a DC micro grid that will be able to supply remote villages with electricity with the possibility to back feed the main grid; providing villagers with the option to sell back the excess to commercial grid suppliers, and creating a sustainable, socio-economic activity.

The department is part of a consortium formed by a number of universities involved in the Erasmus+ Project. The project is funded by the European Union and is focused on DC technologies: how to utilise DC from production to utilisation in order to avoid inverters, making solar systems more efficient.

In 2019, FEBE introduced the new Bachelor of Engineering Technology (B.Eng. Tech) degree – making UJ to be the first University to offer such an accredited qualification in South Africa. The qualification gives participants the necessary education to function as technologists in the fast changing and demanding industrial landscape of South Africa and the rest of the world.

