UNISA

College of Science,
Engineering & Technology

UNISA | college of
science, engineering
and technology

OUR VISION

The vision of the College of Science, Engineering and Technology is to "develop world class, futuristic, African science, engineering and technology leaders, who aspire to extend the frontiers of innovation

OUR MISSION

CSET provides graduates with an enabling environment for advancing science, engineering and technology knowledge that is nationally responsive and globally relevant

OUR VALUES

- Academic Excellence
- Quality Service
- Responsibility and Accountability
- Adaptability
- Equity and Respect
- Integrity

The College of Science Engineering and Technology believes in providing affordable, accessible, high quality, relevant science, engineering and technology programmes as well as cutting edge research and community engagement projects. Our programmes are taught using innovative delivery approaches and mechanisms that support our extensive student base through dedicated academic and administrative staff.

STRUCTURE

The college is home to the School of Science (with four departments), the **School of Engineering** (with three departments) and the **School of Computing**. Qualifications ranging from BSc to doctoral degree level are offered through an open distance learning model.

RESEARCH

FLAGSHIPS AND CHAIRS

CSET supports Unisa's research goals and strategies and focuses on two of its strategic niche areas, namely innovation and capacity building in science and technology, and open distance learning with a specific focus on the teaching of science, engineering and technology.

The college has top-notch researchers of whom 35 have received National Research Foundation (NRF) ratings. Their research interests range from astronomy and mathematics to physics, chemistry and mechanical, civil, chemical, electrical and mining engineering disciplines. CSET is known to be a national leader in areas related to nanotechnology.

Notably, CSET has strong multi-disciplinary research teams working in areas related to water and energy. The Institute for the Development of Energy for African Sustainability (**IDEAS**) and the Institute for Nanotechnology and Water Sustainability (**iNanoWS**) research unit enjoy international recognition for their cutting-edge research.

IDEAS specialises in novel techniques for designing chemical processes with an emphasis on reducing material and energy consumption as well as carbon dioxide emissions, and has successfully completed projects for over 60 local and international companies.

iNanoWS carries out cutting edge research in 6 thematic areas that cover advanced water treatment technologies, the urban water cycle and water quality issues. Working with international collaborators and industrial partners, researchers have already found answers to a number of research questions pertaining to water quality and supply issues. The Institute is at the forefront of integrating nanotechnologies with existing water treatment practices with the goal of optimising the efficiency of conventional water treatment technologies and water quality monitoring.

There are many research groups in CSET, but to focus its research activities the college has identified flagship research projects that relate to two institutional research niche areas and represent research excellence in the college. Current flagship projects include Open Distance Learning (ODeL), IInformation and Communication Technologies for Development (ICT4D) and Topology.

ODEL RESEARCH FLAGSHIP

Higher education institutions all over the world have been struggling to implement ODL teaching in the fields of science, engineering and technology. However, having the advantage of Unisa's experience and expertise as a leading ODL university over many

decades, CSET has been doing ODL research for many years. ODL practice forms a natural area of research focus for CSET and several researchers and small groups within the college are conducting research on various aspects of open distance learning.

DST/NRF SARCHI CHAIR IN ICT FOR DEVELOPMENT

Information and Communication Technology (ICT) is a powerful tool for resolving developing world challenges towards improving the human condition in a sustainable way. The SARChI Chair in ICT for Development (ICT4D) seeks to use ICTs to address developmental constraints, whether financial, infrastructural (such as a lack of internet access) or skills related (as in a lack of ICT and computational skills) in a sustainable way.

Located within the School of Computing in the College of Science, Engineering and Technology, the Chair has an initial lifespan of five years, from January 2016 to December 2020. The Chair has been awarded another five years, to commence from January 2021 to December 2025. The ICT4D chair aims to promote the visibility of South African based ICT4D research and researchers. This is being done by theorising the ICT4D landscape in South Africa, as well as the global and local opportunities and challenges. On a practical level, the Chair founded and maintains an online knowledge repository where details of South African ICT4D researchers, conferences, selected papers etc. can be accessed. This is an important resource for postgraduate students and researchers seeking collaborations. The Chair hosted the 10th International Development Informatics Association Conference (IDIA2018) which further highlighted South African ICT4D research.

The SARChI Chair was partnered with the International network for postgraduate students in the area of ICT4D (IPID) Southern African chapter during 2019 and 2020, funded by The Swedish Program for ICT in Development Regions (SPIDER) - an ICT4D non-governmental organization based in Sweden. This partnership affords students the opportunity to cultivate a larger network and even greater research collaboration efforts.

Human-Computer Interaction for development (HCI4D) is the focus of many of the student projects where the accessibility, usability and user experience of digital applications are researched in terms of developing country needs, expectations and constraints. The Human-Computer Interaction Laboratory in the School of Computing provides facilities to support the user experience research towards promoting knowledge sharing in the African context. A related projects focuses on knowledge creation and transfer through the use of visualisation for tuition and research.

Building research capacity through the supervision of masters and doctoral students The Chair's delivery of postgraduate students, who have access to a well-equipped Human-Computer Interaction Laboratory, as well as on developing productive and constructive collaborations.

TEACHING AND LEARNING

Teaching and learning, research and community engagement are closely integrated at CSET. While teaching in the college informs the ODL research flagship's agenda, the research findings together with other reflexive practices in turn inform CSET's approach to teaching and learning.

Offering short learning programmes (SLPs) is but one way through which CSET integrates its core business areas of teaching, learning and community engagement. SLPs are not formal qualifications, but are designed to meet specific learning needs such as improving access to formal study qualifications at Unisa or catering for specific needs of the workplace.

The college offers qualifications that can be divided into two broad categories: vocational and formative.

VOCATIONAL QUALIFICATIONS

Vocational qualifications are offered by the School of Engineering and the School of Computing.

At the undergraduate level, the School of Engineering offers a range of Diploma and Advanced Diploma programmes in the fields of chemical, civil, electrical, industrial, mechanical and mining engineering. These sought-after qualifications are fully accredited by the Engineering Council of South Africa (ECSA).

The School of Computing offers a Diploma in Information Technology (IT) and an Advanced Diploma in Information Resource Management (IRM), an exciting new qualification that was introduced in 2016. A Postgraduate Diploma in IRM was added to the offerings in 2017.

FORMATIVE QUALIFICATIONS

CSET offers a very wide range of formative programmes, which are mainly located in the School of Science and the School of Computing and include a BSc, BSc Hons, MSc and PhD.

The major subjects to choose from are Applied Mathematics, Mathematics, Chemistry, Physics, Statistics, Computer Science and Information Systems.

Unisa is one of very few universities to offer Astronomy as a field of study, and this subject can be taken from undergraduate level right up to PhD level.

There are also specific bachelor's degrees offered by the School of Computing, namely, the BSc in Computing and the BSc in Informatics.

At honours level the subjects include Computing, Business Informatics, Applied Mathematics, Astronomy, Chemistry, Physics, Statistics and a number of fields concerned with science education.

At master's level, students can choose from Applied Mathematics, Mathematics, Statistics, Astronomy, Chemistry, Computing, Mathematics and Physics, and at Doctoral Level, Applied Mathematics, Statistics, Astronomy, Chemistry, Computer Science, Information Systems, Mathematics and Physics.

SIGNATURE MODULE

All CSET students have to include the college's signature module in their undergraduate curriculum, whether they enrol for a diploma or BSc qualification. This module on Ethical Information and Communication Technologies for Development Solutions encourages students to adopt the qualities expected of a well-rounded CSET graduate and responsible citizen.

LEARNER SUPPORT

CSET prides itself on its learner support, which includes the myUnisa learning platform, discussion classes in selected modules, e-tutors, face-to-face tutors in the modules that students often experience as difficult, and support via e-mail, telephone or face-to-face interactions.

WORK-INTEGRATED LEARNING

The School of Engineering, in its endeavour to produce work-ready graduates, partners with appropriate and willing experiential learning providers. As part of the curriculum of the Engineering diplomas, students are required to complete a year of work-integrated learning under supervision of recognised mentors. Organisations also enjoy substantial benefits by partnering with the relevant School of Engineering departments and by hosting students.

INNOVATION AT CSET (INCUBATION PROJECT)

The goal of the innovation project is to foster innovation and entrepreneurial culture at Unisa, by providing the students, alumni, and communities with opportunities to transform their business ideas to reality. **CSET – I connect** provides the conducive working environment to the incubatees to nurture their innovative ideas.

Through DITTC, Unisa has been building understanding and awareness of the importance of innovation and technology transfer among staff and students. This continues to be a growing activity with more people beginning to appreciate and understand the importance of these concepts in enhancing the impact that the University's research and development can have on society.

COLLABORATION AT CSET

The research laboratories at CSET house state-of-the-art and top-of-the-range equipment. Most of the equipment has been recently commissioned and provide manufacturing and analytical capabilities that are not available in many laboratories in the country but also on the continent in general. In recent years, these laboratories have enabled Unisa to be a major contributor in the area of materials research and nanotechnology for applications in energy storage, remote sensing, water sustainability and other engineering and science fields. The core function of the CSET laboratories is to address current and emerging issues relating to water and energy. These laboratories are equipped with world class research equipment which is used mainly for postgraduate training. The projects carried out in these laboratories culminate in the generation of a class of highly skilled graduates, resourceful in tackling challenges. This in turn addresses important issues that are stipulated in our national development plan (water quality, health and education).

Researchers also have strong and very active regional and international collaborations with their counterparts in world-class institutions. In these collaborations, researchers engage via co-supervision of graduate students and exchange visits (for both students and staff). There are also working collaborations with industry partners that include staff training and technology exchange.

COMMUNITY
ENGAGEMENT

At Unisa, community engagement is a scholarly endeavour in which academics and students, together with participating communities, collaborate in a mutually beneficial exchange of knowledge towards the goal of social transformation and sustainable development.

In line with Unisa's approach, CSET is committed to put to use its expertise in the areas of teaching and research to address issues relevant to its community. CSET CE initiatives are aligned to the National Development Goals (2& 8), Sustainable Development Goals (4, 6, 7) and the African Agenda 2063. CSET is making a significant impact on several communities through the following community engagement projects:

I-SET-TO UNISA SCIENCE ENGAGEMENT CENTRE

Inspired towards Science, Engineering and Technology (I-SET) is a community engagement flagship project of CSET. The aim of the project is to inspire and create awareness of engaged science through the fun activities of robotics. The flagship focuses on science engagement and aspiration while using robotics and programming to enhance learning. It has evolved from team coaching and the development at local schools to coach (educator, student, community leader) equipping and training through workshops, Short Learning Programmes, MOOCS and I-SET Lego League completion national and internationally.

The project in 2021 will transition from being a flagship project to a Science Engagement Centre with the following activities:

- I-SET-Physics and Chemistry Live Online Learning
- I-SET Robotics Live Online Learning
- I-SET Robotics Hub
- I-SET Sasol Mobile Lab Unit
- I-SET Robotics @ Competitions
- I-SET Robotics @ Expos
- Unisa Observatory -Astronomy

COMPUTING FOR COMMUNITIES (C4C)

The main objective of the project is to ensure that relevant computing and research expertise of the staff and students within the School of Computing (SOC) are utilized strategically and effectively to address challenges (social and humanitarian) that affect our local communities. The project has the following objectives:

- To provide the computing and research expertise of the SOC academic and administration staff, students, and interested external stakeholders for free to address social and humanitarian challenges, by empowering local communities through various activities, such as training, skills transfer, open source solution development, community development and social innovation.

- To enable an environment of mutual-benefit and effective collaborations between the University and different stakeholders, such as ICT companies, non-profit organizations, freelance developers, and subject-matter experts.

- To promote the School of Computing within and outside the university, and at the same time realizes the mission of the university in terms of community engagement and outreach, which is "applying its teaching and research competences in addressing challenges that affect societies".

The project has four following themes of focuses: : Cyber Security Awareness, Teen Geeks, Socially Relevant Computing, Clic

TEEN GEEKS

- Introduce digital skills to primary school children through play, thereby closing the opportunity gap for children coming from disadvantaged areas

- Prepare and create a pipeline of young scientists to enter the tech space through early exposure to technology

- Discover talent and harness their passion and knowledge by introducing digital skills like coding to children to help drive and inspire change

- Increase awareness of digital literacies to young children across the nation.

SOCIALLY RELEVANT COMPUTING

The main purpose of this project is to develop information technology entrepreneurs who will address social problems that are existing in different communities. Through industry partnership, current and graduate students are initiated to recent technologies through hackathons.

CLIC

The aim is to train the elders to become familiar with computer technology to ensure that they are not excluded from the enormous potential that computers are benefitting lives. Without access, older citizens are rapidly becoming disenfranchised. Perceived barriers to e-literacy include lack of interest, feeling too old, fear of new technology, lack of access to IT, lack of IT skills and experience, cost, concerns about security, and problems associated with disability

ScienceEdge

The goal of the project is to reach and educate South Africa's scientists of tomorrow. Science is important in the future of South Africa, but there is low levels of learner interest, as well as poor learner performance, in Mathematics and Science at schools. The ScienceEdge project aims to counteract this trend by engaging with learners, educators and other important stakeholders. Its activities are carried out by the following sub-projects.

- **GirlPower:** The GirlPower project aims to develop a generation of girls who are confident, competent and prepared to realise their potential in the field of science, engineering and technology.

- **MathsEdge**: is an academically inspired initiative of CSET. Mathematics is important to all of the disciplines in the college, but learners often think of the subject as "difficult" and out of their reach. MathsEdge brings it closer to their world, offering information about higher education study as well as maths-related careers and about how mathematics can be applied in real-life situations.

- **StatsEdge** aims to promote the role of Statistics as a key competency of critical citizens in the current information-driven society and targets both educators and learners.

- **Astronomy Outreach Programme**. Living up to its slogan, "inspiring our community to reach for the stars", the Astronomy Outreach Programme aims to ignite an interest in the sciences as this might also sway learners to consider following a career in science-related fields. Astronomy is a branch of physical science that can be appreciated without any scientific or mathematical background, because it is so accessible and exciting. Astronomy is of continuous interest to the general public and an excellent tool to inspire a general interest in science. The government has identified astronomy as a key science objective and has shown their support for astronomy by investing in projects such as the SKA, SALT, MeerKAT and HESS.

ENGINEERS WITHOUT BORDERS (EWB)

EWB-Unisa is a volunteer organisation where students and professionals use their skills and expertise to benefit communities and community-based organisations. EWB-Unisa operates under the umbrella of EWB-SA and is aligned with the sustainability development goals.

Projects range from water and sanitation to civil structures, energy, waste and agriculture. With few avenues for students and engineers to be involved in social upliftment projects, EWB-Unisa provides an extra-curricular platform for students to apply what they have learned in their studies to real-world situations, and opportunities for staff to indulge their sense of social responsibility.

APPLICATION OF SUSTAINABLE TECHNOLOGY FOR RURAL AFRICA (ASTRA)

ASTRA is a community engagement project started in the year 2017. This project seeks to introduce an awareness of simple green energy technologies which can be easily adopted by high school learners. Due to increased levels of awareness of the green energy technologies, the learners tend to implement the technologies at their home. Every year there is a different theme around sustainable technology. The learners are given the opportunity to design, build and test their technology devices before they can present their work at an annual learner research summit (LRS) event organised by College of Science Engineering and Technology. ASTRA focused on manufacturing, testing and analysis of the prototypes.

WASTE TO ENERGY

In the Waste to Energy project, the Material and Process Synthesis research unit and Unisa's Institute for Social and Health Science are working together to find a solution to waste disposal in informal settlements, which poses a serious health hazard. Converting waste into energy will not only ensure a cleaner, healthier environment, but also provide access to some form of energy. This will improve the quality of life of many people, as few informal settlements have access to electricity and inhabitants still use candles and paraffin for lighting and cook with coal, wood or paraffin stoves.

SUSTAINABLE NANOTECHNOLOGY SOLUTIONS FOR RURAL COMMUNITIES (NANO4RURAL)

This community engaged project seeks to provide solutions to the existing problems in the disadvantaged communities by employing nanotechnology techniques developed from iNanoWS laboratories. The project provides nanotechnology solutions to water, energy and/or health related problems that the rural communities have experienced over decades. The ultimate goal is to scale-up the current filtration systems which have previously been tested for cleaning water, deploy energy related technologies in particular solar energy systems that are inexpensive; deploy sensors for detection of unwanted pollutants and emerging pollutants in water wells or borehole water.

This project is carried out in partnership with communities in small rural areas situated in different provinces in South Africa, namely Mpumalanga, Limpopo, Northwest Gauteng and KwaZulu Natal provinces and is envisaged to reach a total of 10 000 community members and school learners yearly in the different locations.

MODERN FACILITIES

The Unisa Science Campus offers state-of-the-art laboratories and high-end equipment, thereby advancing science education and research at a national level. It contains 12 buildings, a library, two auditoriums and a large study area. The new laboratories are for teaching and learning, and research purposes. The modern facilities and equipment not only enable the training of both undergraduate and postgraduate students, but also attract international scholars and researchers to the campus to do research or participate in collaborative research activities.

The Science Campus creates an environment that truly stimulates research and innovation, supports researchers and scientists, and meets the educational and training needs of Unisa's distance learning students, at both undergraduate and postgraduate levels.

STUDENTS AT A GLANCE

The Science, Engineering and Technology Student Association (**SETSA**) is a student representative organisation that promotes creative initiatives for student success. The purpose of the student body is to address and serve the academic interests of all CSET students and to develop world-class graduates, to fuel the science, engineering and technology sector. **SETSA** leaders are actively involved with various school and community development projects and offer support to all students.

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