Central University of Technology, Free State

Central University of Technology

Doctoral Research Support

Scope – Infrastructure and Facilities available to support Doctoral Programmes

1. Faculty of Engineering, Built Environment and IT
2. Faculty of Health and Environmental Science
3. Faculty of Humanities
4. Faculty of Management Sciences
5. Library and Information Centre
6. Summary on Graduate Attributes

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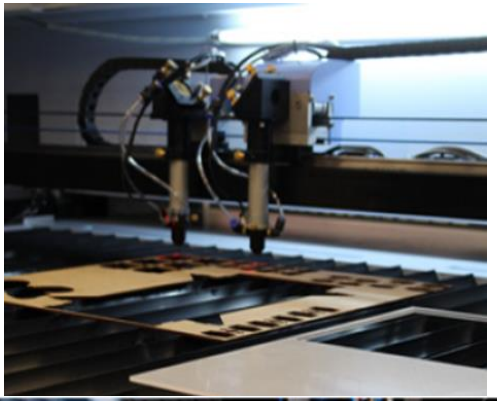
Faculty of Engineering, Built Environment and IT



1. Photos and information is provided for

- Doctor of Engineering in Mechanical Engineering
- Doctor of Engineering in Electrical Engineering
- Doctor of Engineering in Civil Engineering
- Doctor of Philosophy Information Technology

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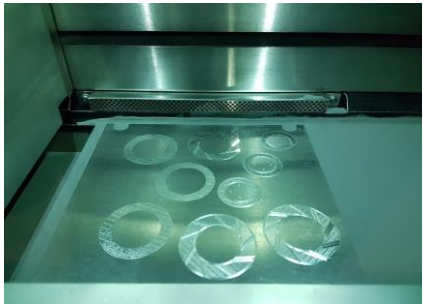
Mechanical Engineering

Research on Additive Manufacturing (AM) has since 2013 been accepted as the primary research theme of the Department of Mechanical and Mechatronics Engineering of CUT, with the Centre for Rapid Prototyping and Manufacturing (CRPM) providing the research infrastructure. Research is also undertaken in other fields such as energy efficiency and renewable energy.

Direct laser sintering machine



Printing of metal parts on one of the direct laser sintering machines in progress

Software:
In addition to the above, a wide range of computer software (Materialise MIMICS™, Magics™, GeoMAGIC™, 3-matic™) for the conversion of computer tomography (CT) and magnetic resonance (MR) scan files into formats suitable for direct implementation into AM machines is available. Design software (SolidWorks, SIGMASOFT™ virtual moulding software, FeatureCam), finite element analysis packages (PATRAN and NASTRAN) and Engineering Equation Solver are also available.

- **Additive manufacturing machines**
  - 2 x Direct metal laser sintering
  - 1 x Metal additive manufacturing
  - 2 x Polymer laser sintering
  - 1 x Sand laser sintering
  - 2 x 3-D photopolymer printing
  - 2 x Stereo-lithography
- **Other equipment**
  - Scanning electron microscope
  - 30kN tensile and compressive strength testing machine
  - Microscope with high resolution camera
  - 3 x 3-D scanners
  - Surface roughness meter
  - Melt flow indexer
  - Polymer injection moulding machine
  - 3 axis CNC milling machine
  - CNC Wire cutter
  - CNC profile plasma cutter
  - CNC lathe

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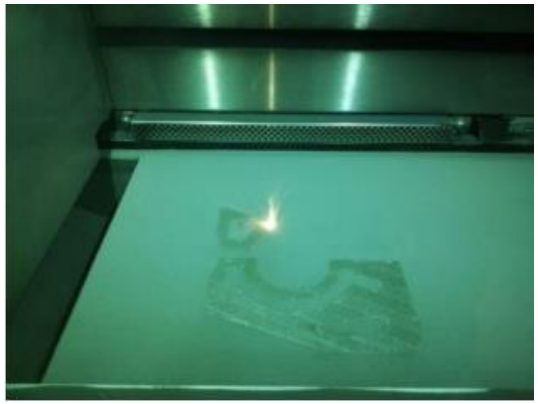
Centre for Rapid Prototyping and Manufacturing



Research focus areas:

- Additive Manufacturing of Medical Implants and Devices, using titanium alloy powders and polymers powders
- Additive Manufacturing of Aerospace Components
- Additive Manufacturing of Advanced Tooling
- Additive Manufacturing for Direct End-use
- Design for Additive Manufacturing as enabling competence
- Energy efficiency improvement and renewable energy

The NRF Chair (SARChI) in Additive Manufacturing for Medical Devices

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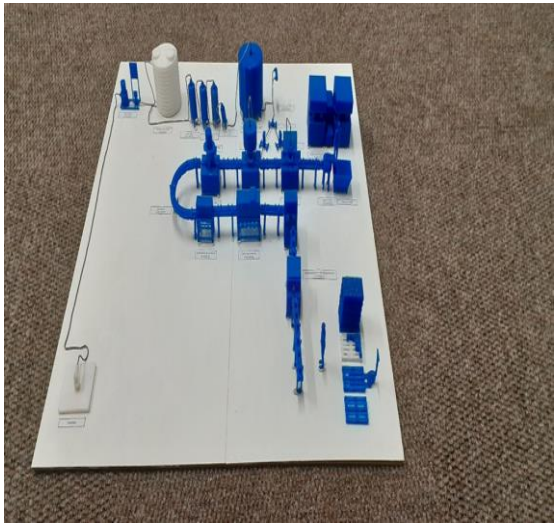
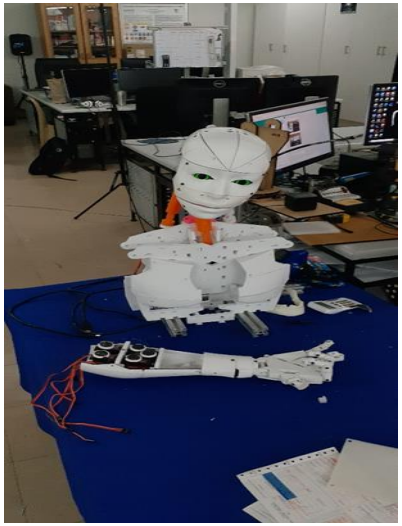
Electrical Engineering





The lab also have Robotics Library for KUKA - DigiMetrix GmbH that give one the ability to externally control the KUKA with labview that makes IR4 research possible

With the aid of 3d printing digital twins and real facilities can and was printed out to scale to evaluate floorspace and visual prestation of a feasibly of facilities

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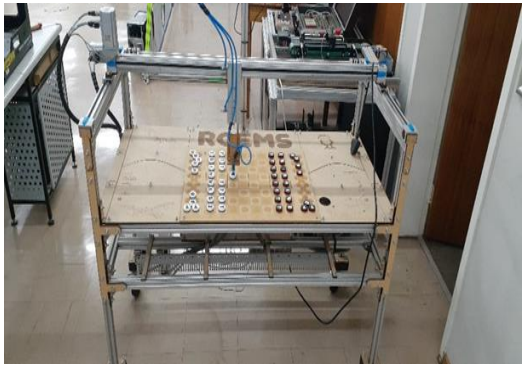
Electrical Engineering

Left: Automatic Guided Vehicle that detects Dactylopius Opuntiae in Cactus Pears



Left: There is varies cartesian robots available and industrial image acquisition cameras and FPGA processors that can assist in automation, IR4 and quality inspection or pick and place research

Above: The research lab has KUKA robot arms that can be used for automation research and with the addition of cameras could and was used for vision quality inspection

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Civil Engineering

In Civil Engineering, postgraduate studies are offered at an M Eng. (NQF9) and D Eng. (NQF10) levels, with the possible specialisation in the following fields:

- Geotechnical Engineering
- Material Sciences
- Transportation Engineering
- Construction Management and Structural Engineering
- Water Engineering

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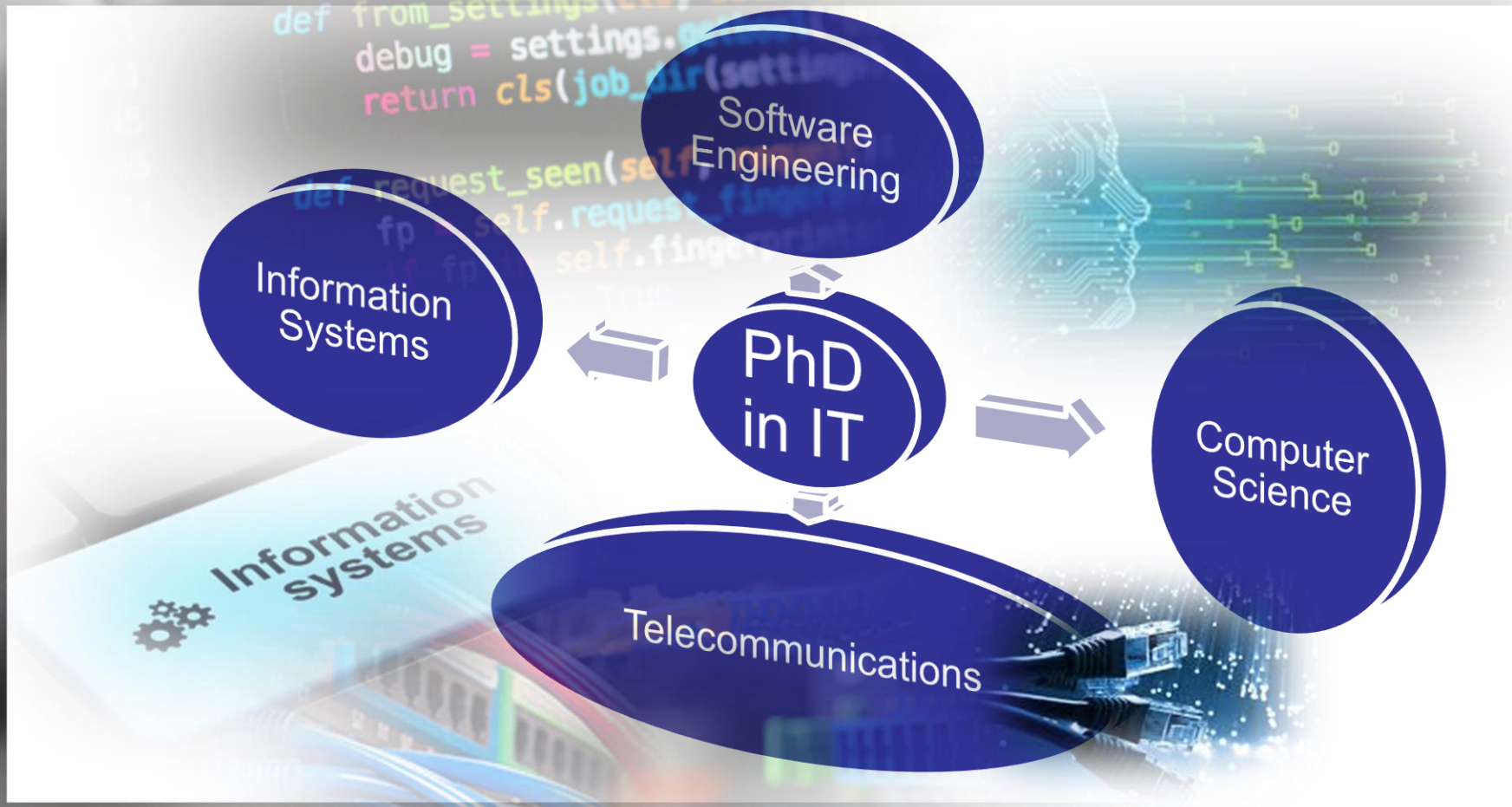
Information technology



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Faculty of Health and Environmental Sciences

- *Doctor of Health Sciences in Biomedical Technology*
- *Doctor of Health Sciences in Clinical Technology.*
- *Doctor of Philosophy in Environmental Health*
- *Doctor Technologiae: Agriculture*

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Faculty of Health and Environmental Sciences

Microbiology is a branch of medical sciences which focuses with the prevention, diagnosis and treatment of infectious diseases. The laboratory is equipped with machinery/equipment that covers various applications of microorganisms for betterment of health. The four kinds of microbes that cause infectious disease namely bacteria, virus, parasites and viruses are covered intensively in the lab. The lab can accommodate 40 students.

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Faculty of Health and Environmental Sciences

Cellular pathology is a branch of pathology science that deals with the study of organs and tissues. The laboratory is equipped with state of the art machines to study any abnormal cell growth. The lab can accommodate 40 students.

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Faculty of Health and Environmental Sciences

Haematology is a branch of medical sciences that deals with the study of the cause, prognosis, treatment and prevention of bloodborne diseases. It involves treating diseases that affect the production of blood and its components, such as blood cells, hemoglobin, blood proteins, bone marrow, platelets, blood vessels, spleen, and the mechanism of coagulation. The laboratory can accommodate 28 students.

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Faculty of Health and Environmental Sciences

Chemical pathology also known as clinical biochemistry. Chemical pathology encompasses the biochemical investigation of bodily fluids such as blood, urine and cerebrospinal fluid. The laboratory is equipped with machinery that enable the discovery of where the body's chemistry has changed, diseases can be diagnosed and monitored. The lab can take 28 students.

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Faculty of Health and Environmental Sciences

General Biology laboratory. Analytical, organic and inorganic chemistry, sample preparation, bioactive component extraction, distillation, homogenization. Students gain technical and conceptual competence

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Faculty of Health and Environmental Sciences

The Centre for Applied Food Sustainability and Biotechnology (CAFSaB) has a fully equipped Molecular Biology laboratory that can seat 10 postgraduate students. DNA, RNA and protein analyses are performed here which include extraction, quantification, characterization and cloning to name a few. Many projects are aimed at detection and quantification of microbial diversity in food, water, wastewater and other environmental samples.

Centre for Applied Food Safety and –Biotechnology (CAFSaB)

Centre for Applied Food Sustainability and Biotechnology (CAFSaB). A smaller room in the Molecular Biology Lab dedicated to Polymerase Chain Reaction (PCR) equipment used for DNA detection, multiplication and real-time analysis. Student are trained on all the relevant equipment that would be available in a commercial Molecular Biology lab. It could be standard identification of a bacterial or yeast isolate using a single gene targeting or analysis of complex data sets such as COVID-19 multiple gene real-time PCR detection.

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The CUT farm situated approximately 33km from the Bloemfontein campus consist of crop and livestock systems. Furthermore, sound infrastructure ie. secured kraaling facilities, prickly pear and pecan nut orchards amongst other, makes the conducting of physical trials possible. These facilities are also utilised for practical training as well as the conducting of short courses.

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Faculty of Humanities & Faculty of Management Sciences

Candidates from both these faculties largely depend of the library facilities. That includes the cubicles and the labs in the Academic Development Centre and the postgraduate space in the University Library.

The Faculty of Humanities have dedicated spaces for their doctoral students at the Welkom campus.

The Faculties of Humanities

And Managenment Science

Students work primarily

with schools, business and

Industry.

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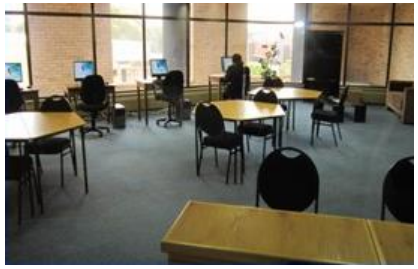
CUT Library and Information Services

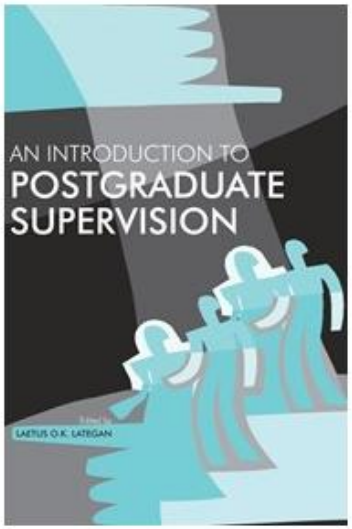


Research support tools to postgraduate students:

- CUT Institutional Repository
- UCTD (Union Catalogue for Theses and Dissertations)
- RefWorks (New Version and Old Version)
- DHET list of approved South African journals
- Impact Factors
- Directory of open access journals
- Free eBooks
- SciELO South Africa
- National ETD Portal
- Postgraduate research facility
- WiFi and 24-hour study halls (pre-lockdown)
- 16 Private study cubicles
- 42 Research comms workstations

Research Publications

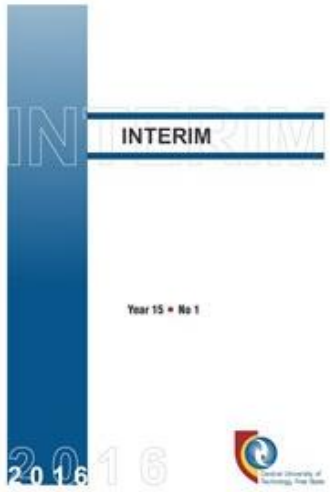
CUT Postgraduate students are supported by institutional publications



CUT Publication: Postgraduate Supervision

CUT Publication: 7 Imperatives for Success in Research

CUT Publication: Doing Research



CUT Publication: RE:search ABC

CUT Publication: Modelling as Research Methodology

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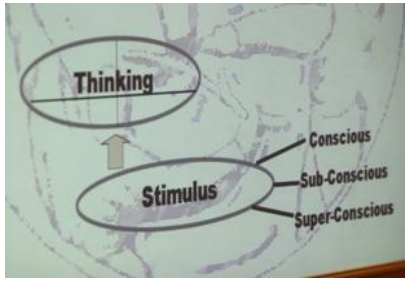
Graduate Attributes through infrastructure and facilities



- **Faculty of Engineering, Built Environment and IT**
  - conceptualizing and creating new knowledge in renewable energy power systems.
  - applying creative and innovative processes to mitigate serious research challenges concerning food security
  - intellectual independence and research leadership
  - understand the theoretical underpinnings of Industry 4.0 and contribute to specialist knowledge in the field
  - ethical concerns and undergoes rigorous checks
- **Faculty of Health and Environmental Science**
  - Students gain technical and conceptual competence.
  - Foster Innovative and creative thinking where scientific research findings and questions are used to solve/find solutions for real world health related problems
  - Understanding and demonstration of depth of specialised disciplinary knowledge and skills related to health, environmental and agricultural sciences to produce future thought leaders in these research fields
- **Faculty of Humanities**
  - original contribution achieved through independent study
  - relevant knowledge and skills
  - contribution to new knowledge
- **Faculty of Management Sciences**
  - promoting independent thinking
  - team collaborative work

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Thinking Beyond