

Department of Mechanical and Mechatronic Engineering

For more information regarding PG Dip in Engineering and MEng Structured (Coursework & Project) programmes:

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FIELDS OF RESEARCH

The main areas of research are as follows:

Energy & the Environment: Fundamental to a modern society and a globally competitive economy is environmentally responsible and sustainable energy generation. In close collaboration with the Centre for Renewable and Sustainable Energy Studies, the department contributes towards fundamental research into a wide range of energy generation technologies. Addressing our transport needs, the group investigates the performance and impact of biofuels and blends in compression-ignition and spark-ignition engines. Uniquely South African solutions to concentrating solar-thermal power and energy storage systems are researched. The group's world-leading research in air-cooled heat exchangers and cooling towers is well known. The group can test fans, heat exchangers and cooling tower fills to international standards. This experimental capability combined with strong computational expertise enable the group to develop special fans, compressors and turbines, e.g. industrial applications, but also ocean current, wind, and solar energy exploitation-, and air-cooled systems. Two phase flow expertise has attracted the nuclear industry's interest with the application of heat pipes as passive heat transfer devices. 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.

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

Solid Mechanics: The group's activities are divided into fundamental research on materials, behaviour of structures and failure mechanisms and criteria. The materials research focusses on power metal (mainly titanium and its alloys) processing and products, continuous fibre-reinforced thermoset composites for aviation components and structures, material property extraction using digital image and volume correlation, characterisation of granular materials and qualification of additive manufactured parts for biomedical and aerospace components. The structures research looks for 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. The research into failure mechanisms and criteria is focussed on composite material failure phenomena, fracture and creep deformation of steels.

Mechatronics, Automation & Design: This group is researching diverse mechatronic systems such as reconfigurable manufacturing systems, unmanned aerial vehicles, robots and medical devices. The research includes development design methodologies for such systems. It finds applications in automation of assembly systems, inspection and quality control using machine vision, reverse engineering, micrometrology and calibration and maintenance of heliostats for concentrating solar power systems.

Computational Engineering: 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. Their work is backed up with excellent experimental work in well-equipped laboratories. The DEM work is applied to mining and earthmoving equipment, particle dampers, conveyors, etc. The optimisation methods are often linked to 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 with emphasis on solidification analysis and segregation. Besides workstations and GPU (graphics processing unit) based computing this work is supported by access to the faculty's cluster computing resources.

The Department offers a master's programme and also individual modules for part-time students. This is aimed at practising engineers who are keen to expand their capabilities without interrupting their work.

POSTGRADUATE QUALIFICATIONS

The Department offers the following qualifications in mechanical engineering (click [HERE](#) for more information):

Postgraduate Diploma in Engineering (PG Dip in Eng)

Master of Engineering Structured (MEng) (coursework and project)

Master of Engineering Research (MEng)

Doctor of Philosophy (PhD)

Doctor of Engineering (DEng)

RESEARCH GROUPS

[Biomedical Engineering Research Group \(BERG\)](#)

[Centre for Renewable and Sustainable Energy Studies \(CRSES\)](#)

[Mechatronics, Automation and Design Research Group \(MAD\)](#)

[Materials Engineering \(ME\)](#)

[Solar Thermal Energy Research Group \(STERG\)](#)

[Sound and Vibration Research Group \(SVRG\)](#)