

Woman in Engineering
Supplement inside: August 2020

CAREERS IN:

Engineering, Science, Technology & Trades



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Proverto Educational Publishers are proud to publish its Engineering, Science, Technology and Trades 2018. This guide covers all aspects of Engineering from University studies to TVET College (previously known as FET Colleges) studies and women in engineering. Among others, the publication focuses on what symbols learners should obtain and the recommended m-scores and criteria.

We hope this publication will guide learners to make informed decisions about their future and open doors and opportunities they did not know exist.

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NOTES:

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CHOOSING A CAREER

Introduction

Choosing a career is one of the most important decisions you will ever make. However, many people make career choices without much career guidance. The importance of career guidance also holds true for students who are choosing a university or specialising field.

By focusing your interests you will have a starting point that is uniquely about you and your career choice. This is only the beginning of career planning and career guidance but a very important first step. With information about your interests, you can now explore a wide range of career options.

With this information at hand, you can develop a career plan. Career guidance is a lifelong process. By starting with an awareness of your personal interests, you can adjust this plan accordingly. A good way to move forward is to involve other people and a variety of career planning resources in your journey of discovery.

In assisting you in receiving career guidance, to do career planning and how to choose a career, websites such as <http://www.careerliftoff.com> and <http://www.pacecareers.com/careercentre/> provide information and advice about careers and career guidance while www.gostudy.co.za is a good career choice site which also provides the most recent list of universities, universities of technology, TVET (FET) colleges, private institutions and short courses as well as information on programmes, study fees, residences and even online applications. The National Youth Development Agency (NYDA) similarly provides comprehensive information about careers. You can visit their website at <http://www.youthconnect.org.za>. A website such as <http://www.biocareers.co.za> specifically provides information about careers in the biomedical sciences and biotechnology fields.

Why is education very important to both your personal and professional life?

Let us assume that you are seeking to achieve some level of success. Depending on this, the level of education may be relative, but the bottom line is, an education of some sort is often paramount to future success. Completing more advanced levels of education shows that you have a drive and commitment to learn and apply information, ideas, theories, and formulas to achieve a variety of tasks and goals.

One of the most apparent reasons education is important is to acquire the subject matter and basic knowledge needed to get by in everyday life. For example:

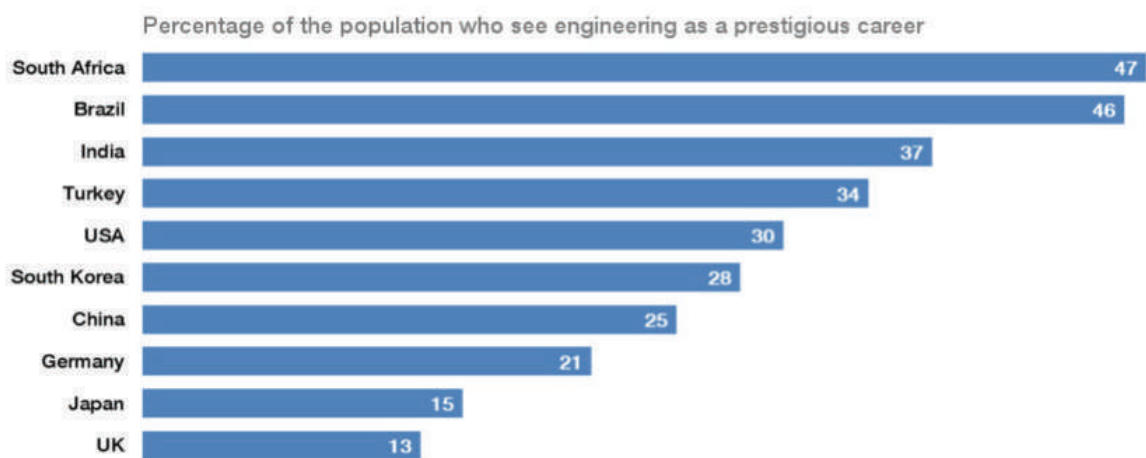
- **English and language skills:** English and language skills will help you to communicate your ideas more clearly. Communication skills are essential in any role – whether you are dealing with co-workers, patients, customers, or supervisors.
- **Maths and science skills:** Although calculators and computers are readily accessible, math skills are imperative for most careers, and for life, and many other everyday activities require math skills, regardless of your career choice.
- **Technology, maths and science are key components of many professions:** Many careers often require knowledge and understanding of the sciences, and technology. These fields are always changing and growing with new developments and discoveries. It is imperative to have a basic understanding you can build on with continuing education throughout your career, to keep up with the latest changes!

WHO WANTS TO BE AN ENGINEER?

Engineering is viewed most highly as a career in South Africa, where 47% of the population consider it to be a prestigious career. This is based on the Queen Elizabeth Prize for Engineering “Create the Future” report.

According to the World Economic Forum (WEF) the report surveyed the opinions of 10 000 people outside the engineering profession in 10 economies. Included in this was the question which 3 professions people see as the most prestigious.

Where is engineering viewed as a prestigious career?



Source: Queen Elizabeth Engineering Prize

The purpose of engineering is one of the findings in the report that stands out. The majority of people in the United Kingdom (UK) and the United States of America (USA) think that engineers are driven by the desire to fulfil a purpose in society, rather than to make a profit. It thus suggests that not all countries feel the same way about engineers.

However, the report also shows that stereotypes about engineers are beginning to fall apart. The world no longer looks to engineers just for bridges and buildings, but for improvements to renewable energy technologies and solutions to global healthcare challenges. The majority of countries in the report have a gender-neutral view of engineering. In the largest emerging economies, almost as many women as men say that they are interested in engineering. According to the WEF this bodes well for a future in which diversity of thought and unconventional thinking will be more important than ever.

Following South Africa in second place in this survey is fellow BRICS country, Brazil, where 46% of the population see engineering as a prestigious profession, with India in third place with 37 %.

Your choice of study

To guide you in making the perfect choice of study, there are certain steps that you may follow to find out what type of career suits you best:

Step 1: Understand what qualification options are available to you (for example, a degree, diploma, certificate or learnership).

Step 2: You can browse the Careers and Occupations Reference Directory for Young People to see what qualification you would need for your career choice and decide on the most practical and best suited for you, among others, a university, university of technology, Technical Vocational Education and Training (TVET) College or learnership. Descriptions of qualifications are given further down this page.

Step 3: Once you have decided on the educational route, get as much information as possible on important issues such as admission requirements, deadlines for application, fees, bursary schemes or loans available and duration of study.

Step 4: If you do not have the funds to attend the course or programme of your choice, see if you are eligible for a bursary, a student loan or a scholarship.

Step 5: Once you have reached your decision, do not delay to apply. Many educational institutions have strict closing dates for applications.

Qualifications

Whatever your choice of education is or will be, always make sure that the service provider – university, college or private educational provider – is accredited, and offers recognised training.

The different recognised qualifications in South Africa are listed below:

- **Degrees:** three to six years of higher education offered by universities. These are referred to as undergraduate degrees and may be followed by post-graduate qualifications such as Honours, Masters or PhD of which the duration is a minimum of one year each
- **National Diploma:** A three-year qualification, offered by universities of technology that offers both theoretical and practical training. After obtaining a National Diploma, learners may enrol for a BTech degree
- **Diplomas:** Qualifications offered by an accredited provider at higher education level, including both theoretical and practical aspects. The duration of the courses may vary
- **Certificates:** One year or less at Further or Higher Education level offered by an accredited provider which includes both practical and skill orientated training.



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ENGINEERING AS A CAREER

INTRODUCTION

Engineering dates back to the earliest development of humankind. It was however only established as a profession during the nineteenth century. As the technologies advanced the need for faster and better innovations grew rapidly. Because of this growing need there exists excellent career opportunities for engineers in basically all sectors of the economy - nationally as well as internationally.

Engineering involves the design, construction and management of products, processes and systems that transform and optimise the commodities that simplify our lives. Engineers study the application of mathematics and science in solving day to day engineering related problems and thus addressing the needs of our society. Engineers are responsible for applying their knowledge in pursuit of sustainable economic development and the progression of humankind.

When choosing a career in engineering it is important to explore the various disciplines that exist in this field which consists of a wide variety of choices and possibilities. A short review of each of the various engineering disciplines is given in this section as well as possible career opportunities.

CHEMICAL ENGINEERING

Chemical engineering involves all the facets of industrial processes where raw materials are converted into higher-value products by means of physical, chemical, thermal, biochemical or mechanical changes. Such processes are applied in the oil, coal, fuel, paper, food and textile industries, and also in mineral processing, water and effluent treatment, and the generation of electrical power. Most industries employ people with training in chemical engineering.

Chemical engineers are involved in industrial processes that convert raw materials into products with a higher economic value. This is done by means of physical, thermal, chemical, biochemical and mechanical changes and processes. Chemical engineers apply their specialised knowledge in the petroleum, food, minerals processing, power generation, and the paper and pulp industries. It also includes environmental engineering activities such as air pollution control. Like other engineering disciplines, chemical engineers are involved in research and development, techno-economic evaluation, equipment and plant design, process control and optimisation, construction, commissioning, operation and management as well as final product marketing and distribution.

CHEMICAL ENGINEERING WITH SPECIALISATION IN MINERALS PROCESSING

Mineral Processing Engineering is a specialisation course offered by a tertiary institution such as the North West University (NWU). It covers the physical and chemical processes which yield especially metals from ores. Industries provide job opportunities to mineral engineers in a wide variety of branches of the profession. It includes research and development, economic evaluation, design, the manufacturing of equipment and construction and putting plants into operation, plant servicing, sale of products and service delivery. Mineral engineers (extractive metallurgists) are mainly employed by the mining companies that operate mines and companies such as Mintek.



CIVIL ENGINEERING

Civil engineers create facilities that improve the quality of people's lives and the environment. This process entails research into the proposed facility, the planning, design and construction of the facility, as well as its continued maintenance. Civil engineers increasingly merge and use environmental management and information technology in their world of wealth creation.

Civil engineers design, build and maintain constructions such as tower blocks and sky-scrapers, dams, canals and pipelines, roads, bridges, tunnels, railways, airports, power stations, television towers, water works and outfall installations. They are involved in financial modelling, feasibility studies and the management and rehabilitation of large asset portfolios.

COMPUTER ENGINEERING

Computer engineering is one of the three internationally accepted and closely-related sub-disciplines of the traditional field of electrical engineering (electrical engineering, electronic engineering and computer engineering). Computer engineering entails the most dynamic and rapidly growing engineering discipline in the vast and constantly expanding field of information and communication technology (ICT). It involves a combination of electronics, computer systems (hardware and software) and communication systems.

The aim of computer engineering is to integrate electronic, computing and control systems in the best way possible to ensure fast, small and powerful systems. Examples of computer engineering include cellphone technology, car control computers for engine management, entertainment systems, security systems, air-conditioning, active suspension and the anti-lock breaking system (ABS). This is an expanding new discipline in engineering with job opportunities all over the world.

A computer engineer is someone with a flair for optimising electronic systems with dedicated computing systems and control software. This includes computer and communication networks of all sizes - from microcontrollers to the worldwide web. The computer engineer therefore

has to be innovative and stay abreast of new technologies and developments in software and hardware.

Computer engineering is used in almost all application fields, especially telecommunications, computer networking, cellphone operations, computer system companies, military technologies (avionics, night vision, electronic warfare, smart bombs, drones, laser target designators), transport technologies (toll roads), internet banking, security systems, consumer equipment, modems, hand-held scanners, voting, medical systems (portable and remote diagnostic recorders), robotics, entertainment equipment, global positioning system (GPS) navigation, measurement and control software, and fibre-optic networks (self-healing networks).

ELECTRICAL AND ELECTRONIC ENGINEERING

Electrical and Electronic engineering are two of the three internationally accepted and closely-related sub-disciplines in the traditional field of electrical engineering (electrical engineering, electronic engineering and computer engineering). There is hardly a technological system in the world that does not rely on electrical power as a source of energy.

Electric Engineers are mainly involved in generating, controlling, distributing, conditioning and applying electric energy. It entails designing, manufacturing, putting into operation and maintaining electric systems. Because new components and methods are constantly developed, renewal and improvement of existing techniques and equipment are accentuated. They also introduce alternative and renewable sources of electrical energy into everyday life. Huge challenges exist for utilising and storing electrical energy from such sources as the sun (solar energy), wind, biomass, water (hydro-energy) and even nuclear energy.

An electrical engineer has a good understanding of basic sciences and a good education in the theoretical and practical aspects (including design, installation and maintenance methodology) of electrical engineering.

The Electronic Engineer is mainly involved in developing micro-electronic circuits as well as control and communication systems, which in turn find general application in all the branches of electronic and electric engineering. Micro-processors and numeric electronic systems lately form the core of most electric and electronic equipment in the industry, the consumption market, the field of medicine, telecommunication, process control, power distribution systems and aviation, as well as in specialist applications such as artificial intelligence

systems. The electronic engineer is someone with a talent for introducing new technologies and upgrading old technologies.

Almost without exception, school subjects such as **Mathematics and Science** are vital for admission to an engineering course at most Universities and Universities of Technology. This is also applicable to Electric and Electronic Engineering as the admission requirements of the Faculty of Engineering of the North-West University indicate:

Faculty of Engineering, University of North-West School of Electrical, Electronic and Computer Engineering			
School Subjects Required	Level	Selection	NSC aggregate
Mathematics (minimum of 70%)	6	APS count of at least 31	Full matriculation exemption
Physical Science (SG) and a minimum of 60%	5	** An admission test must be passed	
Language – At least 60% for first or second language (SG)	5		



quick fact

Ceramic materials are extremely versatile. Their applications range from your average dinner plate to the 'tiles' that prevent space shuttles and capsules from burning up on re-entry into our atmosphere.



INDUSTRIAL ENGINEERING

Industrial engineering (also referred to as business process engineering) studies the systems, processes, technology and people which make up organisations. Industrial engineers are often involved in the processes behind the scenes which are sometimes not that easy to see. For example:

- How do you ensure that fridges all over South Africa are full of your favourite soft drink?
- How are car-makers able to make hundreds of different variations of the same vehicle and still produce these economically, driving a new car off the production line every four minutes?

Industrial engineers are generally responsible for the analysis, design, planning, implementation, operation, management and maintenance of integrated systems. These systems consist of people, capital, material, equipment, information and energy. The aim is to increase the productivity of the organisation and create wealth.

Organisational matters that require optimisation include site selection and layout of facilities, manufacturing, inventory control, materials handling, supply chain management, quality management, cost control, financial services, maintenance, reliability, computer simulation, information systems, human resources and business law.

For obtaining an Industrial Engineering degree at the *University of the Witwatersrand (Wits)*, for example, you must meet the following admission requirements:

Faculty of Engineering and the Built Environment, School of Mechanical, Industrial and Aeronautical Engineering, Wits			
BSc(Eng) Industrial Engineering 4 year degree programme			
School Subjects Required	Level	Selection	NSC aggregate
Mathematics	5	Minimum achievement point of 36 and above	Full matriculation exemption / university endorsement
Physical Science	5	** Maths Literacy candidates are not eligible to study in the School of Mechanical, Industrial and Aeronautical Engineering (Wits)	
English as the Language of Learning and Teaching (LOLT), Home Language or 1 st Additional Language	4		

MECHANICAL AND AERONAUTICAL ENGINEERING

Mechanical and aeronautical engineering entails the application of science to design, manufacture, operate and maintain mechanical and aeronautical equipment and processes. The undergraduate course focuses on the establishment of a broad knowledge of engineering and includes subjects such as dynamics, strength of materials, thermodynamics, fluid mechanics and design. The outputs of mechanical and aeronautical engineers include products and services that add value to the economy of the country. Mechanical and aeronautical expertise is instrumental in the design and manufacture

of products and services, for example, the provision of electricity and water, transport (road, railway and air), mining activities, mechatronics and air-conditioning. As a result of the broad technical background, mechanical and aeronautical engineers often develop into very successful senior managers towards the latter part of their careers. Among others, the University of the Witwatersrand and the University of Pretoria offer aeronautical engineering courses.

An institution such as the University of Pretoria has the following admission requirements for this field of engineering which also apply to all their other engineering courses:

Faculty of Engineering, Built Environment and Information Technology, School of Engineering, University of Pretoria			
BEng (Mechanical Engineering) 4 year degree programme			
School Subjects Required	Level	Selection	NSC aggregate
Mathematics (minimum of 70%)	6	An admission point score (APS) of at least 35	NSC aggregate National Senior Certificate with university endorsement
Physical Science (minimum of 70%)	6		
Afrikaans or English	5		



METALLURGICAL ENGINEERING

South Africa is blessed with the world's largest mineral deposits of gold, chromium, platinum, vanadium and manganese. This country also has large reserves of iron, lead, zinc, copper, nickel, coal and diamonds. The minerals industry contributes to some 50% of South Africa's exports and is one of the largest employers in the country. The metallurgical engineer plays a key role in the production of minerals and metals. Metallurgical engineers help to process metals into final products with added value. In this way, maximum income is generated in international markets.

Metallurgical engineers unlock the riches of deposits of metal ores, coal and diamonds and optimise the manufacture of metal components. They work in plants where valuable minerals are recovered from ore, where metals are produced out of the minerals and where the metals are converted into useful materials – such as steel or aluminium. Careers include production engineers, plant managers, consultants and researchers.

MINING ENGINEERING

The profession of mining engineering encompasses a wide spectrum of engineering work – from mine evaluation to industrial control. For instance, mining engineers may undertake the evaluation of a new mining project as soon as the discovery and geological confirmation of a mineral deposit have been completed. If such a mineral deposit is found to be viable, mining engineers will design the mine to exploit the mineral deposit. Where the mineral deposit is close to the surface, an opencast mine will be preferred, but for deeper deposits, an underground mine will be planned. Mining engineers will coordinate the construction of such a mine and bring it to the stage where it starts producing.

MECHATRONIC ENGINEERING

Mechatronic engineers develop and produce machines and systems that use modern control systems for greater adaptability, better performance, and/or lower costs. Mechatronic systems strive to reach the optimal combination of mechanical, electrical and electronic subsystems by integrating, for example, machine parts, sensors and actuators, and using computer systems as controllers. The range of typical mechatronic systems now being designed and developed is wide and may include anything from engine control units to ABS braking systems, automated assembly lines, artificial hearts, medical devices and consumer products like washing machines.

A *BEng (Mechatronic)* degree programme is offered by the Faculty of Engineering of the *University of Stellenbosch*. This programme consists of modules from the BEng (Mechanical) and BEng (Electrical and Electronic) programmes. In the third and fourth years, students study subjects such as Electronics, Electrical Drives, Control Systems, Computer Systems, Machine Design and Mechatronics. Subjects such as Project Management, Noise and Vibration, Heat Transfer and Environmental Engineering serve to broaden the interdisciplinary base.

South Africa has a sustained demand for mechatronic engineers. Some mechatronic engineers work for large multinational corporations, but the diverse education of mechatronic engineers is sought after in smaller engineering concerns and serves as an excellent base for entrepreneurs.



School Subjects Required		Faculty of Engineering, University of Stellenbosch Department of Mechanical and Mechatronic Engineering	
Subjects	Level	Selection	NSC aggregate
Mathematics	6	Candidates are subject to selection according to selection criteria ** Write the National Benchmark Tests AQL and MAT	At least 60%
Physical Science	5		
English Home Language <i>or</i>	3		
English First Additional Language <i>or</i>	5		
English First Additional Language <i>and</i>	4		
Afrikaans Home Language <i>or</i>	3		
Afrikaans First Additional Language	5		

AGRICULTURAL ENGINEERING

Agricultural Engineers utilise technology to connect the living world of plants, soil, water and animals, with engineering (systems, structures and machines). The Engineer who is the creator and moulder of modern technology plays a vital role in the economic development of a country, as does the agricultural engineer who applies the engineering principles of science and technology as well as his or her knowledge.

Agricultural engineering provides challenging career opportunities in various job functions such as research, testing, development, design, consulting, management, engineering surveys, and planning and counselling. Important work areas include:

- **Water supply and irrigation:** In this field the agricultural engineer is involved with hydrology and farm dam design; canal, pipeline and pump systems; sprinkler, drip and micro-irrigation systems; mechanised irrigation; surface irrigation and drainage
- **Agricultural mechanisation:** Agricultural machinery plays a primary role in the production of food. The agricultural engineer, with knowledge of mechanical techniques as well as soil and plants, assists producers, contractors and farmers in: tractor and other engine tests; development of new machinery; design of agricultural equipment, and agricultural energy research and consultation
- **Soil conservation:** The agricultural engineer's civil know-how is essential for the planning and design of, among other things, conservation and reclaiming structures; systems for the safe discharge of flood water and adapted farming practices to enhance soil conservation
- **Agricultural buildings and structures:** Well-planned functional buildings are required for a successful agricultural industry, including buildings for the intensive production of meat, dairy products, poultry and eggs, glass houses and plastic tunnels for intensive production of flowers and vegetables, and buildings for the storage and processing of products such as maize, tobacco, milk and fruit

- *Food and fibre processing:* The agricultural engineer must guide entrepreneurs in drying, milling, mixing, compacting, cooling and heating of agricultural products and handling, storing, transportation, and packaging systems, for example, fruit, vegetables and meat.

The agricultural engineering programme is termed differently by different universities namely: biological and agricultural engineering, and processing engineering and bioresource engineering.

A four-year course in agricultural engineering is offered by, among others, the School of Engineering the University of Kwazulu-Natal

In order to apply for a BSc in Engineering (including agricultural engineering) at UKZN, prospective students must have:

School Subjects Required		School of Engineering, University of Kwazulu-Natal College of Agriculture, Engineering and Science, UKZN	
Subjects	Level	Selection	NSC aggregate
Mathematics (minimum of 70%)	6	At least 33 Matric Points (excluding Life Orientation)	National Senior Certificate with a Degree endorsement
Physical Science (minimum of 70%)	6		
** Mathematical Literacy is not accepted as a replacement for Mathematics			

A minimum of three years in-service training leads to registration as a professional engineer.



UNIVERSITY OF TECHNOLOGY

By studying a three-year course in engineering at a *University of Technology*, a student is also afforded the opportunity to enter a career in agriculture as a technician. Various bursaries are available from the Agricultural Research Council (ARC) and the Department of Agriculture, Forestry and Fisheries (DAFF).

For those who want to qualify themselves as technicians or technologists in an agricultural specialising field, most Institutions of Technology offer an N.Dip.

The South African Institute of Agricultural Engineers (SAIAE) promotes and protects the collective interests of the *agricultural engineers* in South Africa and joins them in a professional group. The Institute has international contact through its affiliation to the International Commission for Agricultural Engineers (CIGR) in Paris, France.

CAREER OPPORTUNITIES

Work is offered by Departments of Agriculture, various Government Departments, development organisations, manufacturers of agricultural equipment, fertilizer and irrigation companies, farming companies and organisations such as the sugar industry and Consulting Engineers.

A unique postgraduate qualification in Nuclear Sciences and Engineering at the North-West University

The North-West University is the first in South Africa to which a professorship has been awarded in nuclear engineering. The School of Mechanical and Nuclear Engineering in the Faculty of Engineering presents two postgraduate programmes in nuclear engineering, namely an MEng and an MSc in 'Nuclear Engineering. Introductory modules ease the transition from relevant BEng degrees. Students who obtain a BEng in Chemical Engineering or Mechanical Engineering can apply for exemption of these introductory modules.

The programmes are presented over a period of two years (full time) and give access to PhD studies in Nuclear Engineering. The North-West University (NWU) has already been involved in

research in this field with a view to expand South Africa's nuclear power generating potential. By means of these programmes, the NWU affords students the opportunity to become involved in new nuclear power projects in SA such as the Pebble Bed Modular Reactor (PBMR) and building new conventional nuclear power stations

CAREER OPPORTUNITIES IN ENGINEERING

Excellent job opportunities exist for engineers in practically all sectors of the economy; both locally and overseas.

After a number years of in practice, engineers can be successful in one of various occupational fields in accordance with their own potential, personality and work preferences:

- An entrepreneur that owns and operates his own consulting and/or manufacturing company
- An academic at a university
- A researcher at a university or a research entity in the private sector
- Design engineer
- Project engineer
- Engineering consultant
- Production and/or maintenance engineer; and
- Manager in a company up to the highest level



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BACHELOR OF SCIENCE (BSc) IN CONSTRUCTION STUDIES

A BSc in Construction Studies is an undergraduate course similarly offered by the *University of Cape Town* (UCT) and equips students with the knowledge and expertise to occupy a broad range of managerial positions within the construction industry. During their *three* years of study, students learn about design, construction and the latest engineering technologies, while gaining a solid grounding in subjects such as economics, statistics, human resource management, commercial and contract law, costing, surveying and professional communication. Practical exercises are an integral part of all three year's curricula. *Among others, a minimum of 75% in Mathematics and 65% in Physical Science is required for possible admission to the course as well as a National Senior Certificate with university endorsement. The National Benchmark Test (NBT) also has to be written.*



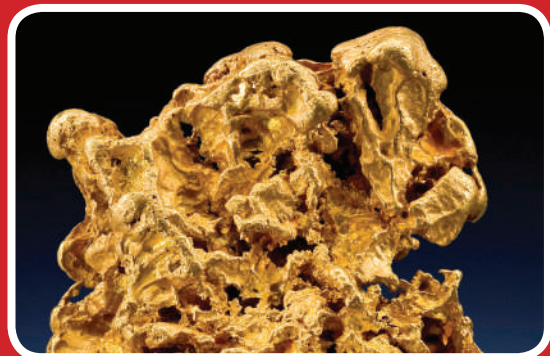
PROPERTY STUDIES

Property Studies provides graduates with a broad knowledge base appropriate to the property industry including finance, economics, property law and relevant communication and computer skills. The students are also educated in the specialist areas of property valuations and managing the entire property development process. More specifically this would entail evaluating and structuring finance for property developments, assessing risk, valuing property assets, managing property portfolios, facilities management programmes, and managing the procurement of buildings.



quick fact

The purity of gold is measured in 'carats'. This word is derived from the Latin term *carob*, which means 'seed' and actually refers to the seeds of the carob tree. Although they were inedible, the seeds were so uniform in weight (about 0,2 grams each) that they were used as a unit of weight in classical times. Today, 24 carats indicates 'pure' or fine (99,9%) gold.



School Subjects Required		School for the Built Environment, University of Pretoria BScLArch (Bachelor of Science Landscape Agriculture)	
Subjects	Level	Selection	NSC aggregate
Mathematics (minimum of 70%)	4	Admission Point Score of at least 27	National Senior Certificate with university endorsement
Physical Science <i>or</i> Geography <i>or</i> Life Sciences	4		
Afrikaans <i>or</i> English	5		

BACHELOR OF TOWN AND REGIONAL PLANNING

Town and regional planning is a profession that promotes and manages change through the planning, design, implementation and management of public interventions in the development and use of land. These interventions can vary from building site level to supranational level and aim at widening choice, promoting equity, ensuring sustainable human settlements and improving the quality of people's lives. The guiding motive of the profession is the generation of viable alternatives to existing settlement types.

BSCARCH - BACHELOR OF SCIENCE ARCHITECTURE

The BScArch 3 year degree programme enables graduates to register with the South African Council for the Architectural Profession (SACAP) as candidate architectural technologists. The qualification is the first step to future registration as a candidate senior architectural technologist or a candidate architect. In practice, technologists and/or junior designers provide assistance in the disciplines of architecture, interior design and urban design. Their responsibilities include design development, documentation of projects, project administration and site management. Among others, the *University of Pretoria* offers this qualification in Architecture.

Admission requirements include Afrikaans or English at performance level 5, Mathematics and Physical Science at level 4 and an admission point score (APS) of 27. Selection includes an interview.

BACHELOR OF ARCHITECTURAL STUDIES (UCT)

The Bachelor of Architectural Studies is a three year, undergraduate, full-time degree programme offered by the *University of Cape Town*. It focuses on the design of the built environment and architectural design. Contextually and socially located architecture is used as the medium to develop foundational design ability which is easily transferable to the range of graduate professional degree streams in Architecture, Landscape Architecture, City and Regional Planning, and Urban Design.

The study and practice of architecture involves the design of buildings and their associated places, and incorporates aesthetic, theoretical and practical concerns. Built environment designers have to engage with an interconnected range of issues: social, cultural, developmental, contextual, environmental, technical, and financial.

This programme equips you with the ability to solve design problems imaginatively, to think rationally and to exercise appropriate judgement within the discipline of architecture in urban and natural contexts. In particular it aims to develop the capacity to design appropriately within the built and natural environment.

It benefits from the related graduate programmes in Architecture, Landscape Architecture, Urban Design and City and Regional Planning. In addition, it offers entry into the architectural, planning and design marketplace, into property development, the building industry, the IT industry and many other fields of employment where design and organisational skills are required.

CAREERS IN SCIENCE AND TECHNOLOGY

Related fields in construction, the built environment and land / engineering surveying

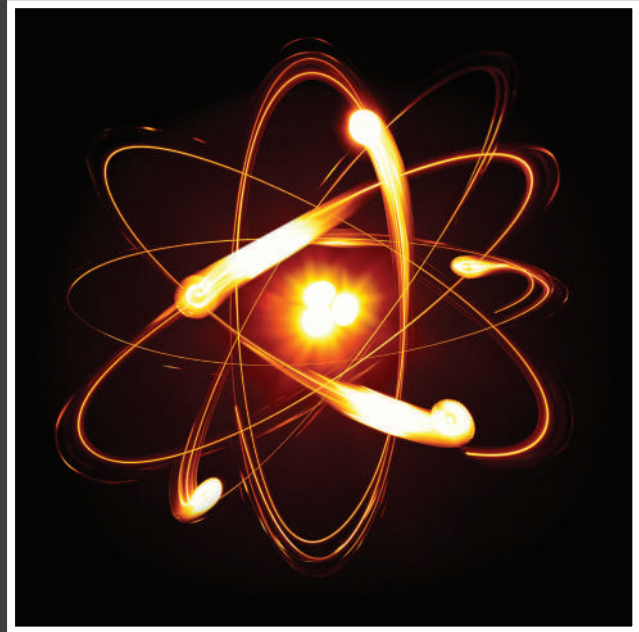
BSc CONSTRUCTION MANAGEMENT

Construction managers are business people who work as contractors, project managers and/or property experts in the built environment. The study programme focuses on the technical, financial and managerial aspects of construction. The construction manager can add value to almost any building-related activity. In the three-year programme, some financial and managerial aspects are touched on, but the main focus is on the technical aspects.

During the two-year honours degree following the BSc degree, students receive further training in aspects such as financial management, project management and strategic management. Among others, this programme is offered by the University of Pretoria.

BSc SCIENCE INTERIOR ARCHITECTURE

This programme in interior architecture is one of only four similar programmes in South Africa with educational membership at the International Federation of Interior Architects and Designers (IFI). The BScInt qualification of the *University of Pretoria* enables graduates to register with the South African Institute for the Interior Design Professions (IID) as candidate interior designers. This qualification is the first step to future registration as candidate senior interior designers or candidate interior architects. In practice, candidate designers provide assistance in interior design and architecture. Their responsibilities include design development, the documentation of projects, project administration and site management. The programme also enables graduates to access the related fields of exhibition, stage and lighting design.



BScLARCH - BACHELOR OF SCIENCE LANDSCAPE ARCHITECTURE

The BSc(LArch) qualification (3 year duration) of the *University of Pretoria* enables graduates to register with the South African Council for the Landscape Architectural Profession (SACLAP) as Candidate Landscape Architectural Technologists. In practice, technologists and/or junior designers provide assistance in the disciplines of landscape architecture, environmental planning and management, architecture and urban design. Their responsibilities include assessments and reports, the documentation of projects, project administration and site management. This qualification is the first step to future registration as a candidate landscape architect.

FOCUS ON: GEOMATICS

If you are eager to develop your knowledge and understanding of society's needs and possess the desire to contribute to the quality of life of all South Africans as well as the management of our heritage, then a career in the field of Geomatics is for you. Geomatics is both an applied science and a professional discipline and it refers to the integrated approach of measurement, analysis, management and display of spatial data. Using the latest satellite, laser and information technology, Geomatics professionals are involved in planning, conducting and managing activities related to land and engineering surveying, information systems, land development and planning, land reform, law and commerce. Geomaticians are making use of technological advances and branching into new and challenging areas of specialisation and research.

The University of Cape Town (UCT) was the first university in southern Africa to offer a degree in surveying and also to embrace the expanded discipline of geomatics. It remains one of the few institutions offering GIS specialisation at an undergraduate level and is recognised nationally and internationally for its excellence in geomatics education.

WHAT IS GEOMATICS?

Geomaticians are making use of technological advances and branching into new and challenging areas of specialisation and research.

There is a shortage of professionals in surveying, geographic information science (GIS) and remote sensing in South Africa and abroad, resulting in good employment prospects. Career opportunities exist in private practices, aerial survey companies, offshore survey companies, mining houses and government. This is an ideal career for a person who enjoys mathematics and would like to have independence in their day-to-day work.



BSc GEOMATICS (UNIVERSITY OF CAPE TOWN)

ABOUT THE DEGREE

The BSc Geomatics degree is a four year undergraduate degree. The degree is split into three streams, namely the:

SURVEYING STREAM

This is the traditional degree upon which the degree programme was founded in the 1930s and its design is similar to other engineering degrees on offer in the faculty. This stream allows to you register as a professional land surveyor. A surveyor is likely to specialise in one or more of the following areas:

- **Cadastral surveying:** The cadastral surveyor determines the position of boundaries between properties;
- **Engineering surveying:** The skills of expert engineering surveyors are required to enable complicated structures such as dams, super-elevated freeways and long tunnels to be built;
- **Geodetic surveying:** Geodesists are involved in determining the size and shape of the earth, the variation in its gravitational field and the movement of its land masses;
- **Hydrographic surveying:** Hydrographic surveying has arisen out of the increasing interest in the earth's coastlines and the continental shelves as a source of oil, minerals and fish;
- **Topographic surveying:** This involves aerial photogrammetry (mapping by applying maths equations to photographs) and satellite remote sensing to ensure the correct position of structures;
- **Geographic Information Systems (GIS):** A GIS specialist is an expert in spatial data acquisition, analysis and management;

- **Cartography:** Involves the making of maps and, more recently, the use of 3D computer graphics to model and present different phenomena;
- **Land management:** Land is fundamental to human existence and surveyors have been involved in managing land for centuries.

GEOINFORMATICS STREAM

This stream provides a foundation in surveying, GIS, remote sensing, mathematics, land law and land management. Students choose a third-year level major subject in another area of specialisation in the Faculty of Science. Currently, the programme allows for a major in Computer Science, Environmental and Geographic Science or Geology.

Computer Science

While some computer science graduates have worked in developing software applications related to the location of cell phones for a variety of business and government applications, others have worked in developing GIS applications and software. General IT positions or IT management consultant positions are also available to these graduates.

Environmental and Geographic Science

For the graduate who has majored in environmental and geographic science (EGS) opportunities exist in areas such as environmental consultancy, GIS, environmental law, training and education, or environmental science.

Geology

Majoring in geology, graduates will be well prepared for a career involving the analysis and management of geological information. These skills and knowledge are very much in demand in the mining and mineral exploration field and by independent mining information consultancies. The spatial statistics, analysis and modelling components provide a geologist with a qualification that gives them an edge over many others in their discipline.

PLANNING STREAM

This stream makes it possible for students to be awarded a BSc (Geomatics) after four years of study and a Master of City and Regional Planning (MCRP) in their fifth year. Graduates can register as professionals with the Council of South African Town and Regional Planners (TRP-SA).

Students complete three years of the BSc (Geomatics) in Surveying core courses. The fourth year is a combined Planning/Geomatics programme and, finally, they complete the Planning programme in their fifth year.

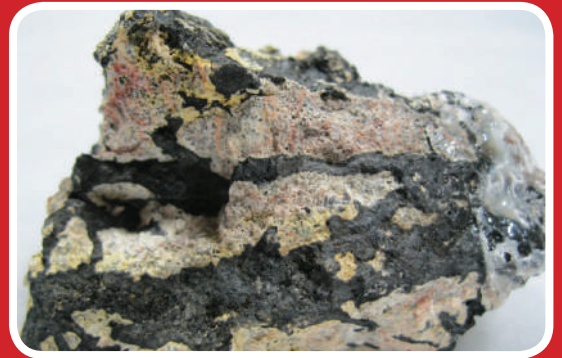
Town and regional planners continually work with spatial information and often with cadastral surveying information. In practice, planners who can use GIS to do modelling, analysis and scenario simulation are more employable as the use of GIS, in much the same way that spread sheets have been used to do simulations, is increasingly becoming a service that planners offer their clients.

For more information on this field of study go to www.uct.ac.za



did you know?

South Africa is one of the largest producers of chromite? The electric arc melting of this oxide mineral produces ferrochrome, which is widely used in stainless steel products. Through its innovations, the Pyrometallurgy division supports and contributes to our local ferrochrome industry.



BComm (Economic Sciences) – Various Universities

This programme focuses almost exclusively on fields of study in economics. Because of the importance of statistics for the development of high-level economic analysis, Statistics or Mathematical Statistics up to the second-year level is a prescribed subject in this programme.

Students who intend following a career as an economic or financial analyst or consultant should register for this programme. The focal areas that students choose will largely determine the kinds of jobs they come in line for. See below for the **focal areas** offered by this programme and the different lines of work they help prepare you for.

Economics

The financial sector offers excellent career opportunities for those who choose economics as their focal area. Qualified people will typically be employed as economic or financial analysts. Other career opportunities include economic or management consultancy.

Transport Economics

As transport economist you will apply skills including predicting the demand (for example, the number of trips and choice of transport mode) and supply (capacity of transport modes) and studying methods of financing maintenance, improvement and expansion of the transport network (such as tolls and road user charges).

Considering employment opportunities, transport economists often serve as consultants to government institutions, private transport companies and the private sector.

BSc ConSecol (Conservation Ecology) – University of Stellenbosch

Offered by the *University of Stellenbosch*, this unique programme, with an emphasis on social-ecological systems, equips you to work at solving the world's conservation challenges. You will have a choice of careers in environmental impact assessment and monitoring (terrestrial and freshwater), restoration ecology, game farm management, ecotourism, community-based natural resource management and environment-oriented, sustainable production in agriculture and forestry (including organic plant management), in conservation planning, and in conservation biology research.

The four-year programme kicks off with modules in Biology, Chemistry, Geo-environmental Science, Computer Skills and Mathematics. During your second year you will be studying subjects dealing with conservation ecology, biodiversity and applied sciences, such as Geographical Information Systems (GIS), Biometry and Microbiology. The third year will focus on Conservation Ecology, Biodiversity and Ecology, as well as a choice of Soil Science, Environmental Sociology or Genetics. During the last year of the course all the skills that were gained in the first three years are integrated in order to focus on the big and burning issues in conservation.

In addition to this, hands-on practicals are performed in all four years of the programme. In the last year there is also a choice either to develop your own comprehensive conservation plan for a game farm, game reserve or nature area or to conduct a research project on a pre-determined conservation issue. Because of the extinction crisis, the demand for such specialised knowledge is growing worldwide.



School Subjects Required		Faculty of AgriSciences, University of Stellenbosch Department of Conservation Ecology and Entomology	
Subjects	Level	Selection	NSC aggregate
Mathematics	4	** Write the National Benchmark Tests AQL and MAT	At least 55% (excluding Life Orientation)
Physical Science <i>or</i>	4		
Physical Science <i>and</i> Life Sciences	3 4		
<i>or</i>			
Physical Science <i>and</i> Agricultural Sciences	3 6		
English <i>or</i> Afrikaans (Home Language <i>or</i> First Additional Language)	4		

AGRICULTURAL AND FORESTRY SCIENCES HORTICULTURE

South Africa is a big exporter of fruit and flowers. To be successful needs thorough research and knowledge of improved production, handling after it was harvested (the use of controlled atmospheric conditions for the improvement of fruit's shelf-life and quality), marketing and quality control.

Xylology

Discover the wonder of wood – weave a magic chain of wood from the forest to the consumer. Xylology concentrates on three main areas, namely the drying of wood, wood protection and wood pulping. The end products that are studied are furniture, laminated products, wooden floors, roof frames, wooden houses and bridges, as well as wooden finishes such as ceilings and panels and wood as structural material.

Agricultural Economics

Subjects such as farm management, rural and agricultural policy, agricultural marketing, environmental management and resource-economics, agricultural production and resource management, and international trade and marketing are studied.

PLANT PATHOLOGY

This field is the study of biotical and a-biotical plant diseases, especially those that are caused by fungi and bacteria. Pathogens are organisms that are causing diseases in plants. With the current tendency in chemical-free agricultural products, the answer lies in the biological control of plant pathogens, therefore, DNA characterising of plant pathogens, the identification of host resistance to plant diseases and the control of foreign intruder plants and pests, are important study fields.

FOOD SCIENCE

Food science entails the study of food, from the farm or water, until it is eaten or drunk. The great variety of food products on the shop's shelves is a result of the research and development that are done by food scientists. Basic knowledge is used to determine the causes of decay and to find better methods to provide food more freshly, nutritious and tasty to consumers.

VITICULTURE AND OENOLOGY

A grapevine is a unique crop – follow the wonder of the microscopic development of the first small flower to the bottling (wine) or packaging (table-grapes) of a unique product. Learn to physically and bio-technologically manipulate the plant-physiological processes of the grapevine and to prepare the full spectrum of wine products – from dry white wine to brandy – in an environmentally-friendly industry.

The Department of Viticulture and Oenology at the *University of Stellenbosch* (Faculty of AgriSciences) is the only University-based department in South Africa that offers graduate and postgraduate courses in Viticulture and Oenology. The department has at its disposal well-equipped research facilities, including experimental and commercial vineyards, a small-scale teaching experimental cellar and an industry-scale research and training cellar.

Department of Viticulture and Oenology, University of Stellenbosch BScAgric (Viticulture and Oenology (General)) 4 year course			
School Subjects Required	Level	Selection	NSC aggregate
Mathematics	4	Achievement of at least 55%, calculated in a ratio of 40:60 for the University of Stellenbosch Access Tests and the average (excluding Life Orientation) obtained for the NSC	National Senior Certificate as certified by Umalusi; an achievement level of at least 4 in four designated university entrance subjects
Physical Science <i>or</i>	4		
Physical Science <i>and</i>	3		
Life Sciences	4		
Afrikaans or English	4		

LIVESTOCK SCIENCE

Livestock Science is the science in which the feeding, breeding physiology and production of farm animals, game as well as dogs and cats are studied. It concentrates on those aspects of big stock, small stock, pigs and poultry that are of economic importance to man. Livestock Science is a comprehensive field of study that includes a variety of industries, such as milk production, poultry, pigs, ostriches and the feeding of companion animals.

STUDY AT A UNIVERSITY

The BSc (Bachelor of Science), the usual 'first degree' in the appropriate Faculty, requires a minimum of three years' study after school. The BSc (Hons) may be regarded as a fourth year to an ordinary BSc. The MSc (Master of Science) and PhD degrees are awarded after postgraduate research study, and the writing of a thesis.

STUDY AT A UNIVERSITY OF TECHNOLOGY

The National Diploma is awarded after three years' successful study. After the fourth year a B.Tech Degree (Bachelor in Technology) will be awarded. After the fifth year the M.Tech Degree (Master of Technology) will be awarded and thereafter the D.Tech Degree (Doctorate of Technology).



EARTH AND ENVIRONMENTAL HEALTH

INDUSTRIAL HEALTH AND SAFETY MANAGER

Think of all the jobs in the world that involve machinery, chemicals, toxins, radiation, loud noise, or travel to places above or below Earth's surface—all of these jobs carry an element of risk to the workers. Industrial health and safety professionals work to minimize this risk. They inspect work sites and help workers and companies understand and comply with safety laws. They use their knowledge of mechanical processes, chemistry, and human psychology and performance to anticipate hazardous conditions. Protecting workers requires excellent communication skills and a strong sense of responsibility. They:

- Make sure that chemicals are stored safely in a manufacturing plant.
- Recommend that additional emergency shutoff switches be installed to stop an assembly line.
- Inspect machinery and pipes to make sure they can withstand every day wear and tear.
- Check that employees are following safety regulations, including wearing safety gear.



ENVIRONMENTAL SCIENTIST

Have you ever noticed that for people with asthma it can sometimes be especially hard to breathe in the middle of a busy city? One reason for this is the exhaust from vehicles. Cars, buses, and motorcycles add pollution to our air, which affects our health. But can pollution impact more than our health? Cutting down trees, or deforestation, can contribute to erosion, which carries off valuable topsoil. But can erosion alter more than the condition of the soil? How does an oil spill harm fish and aquatic plants? How does a population of animals interact with its environment? These are questions that environmental scientists study and try to find answers to. They conduct research or perform investigations to identify and eliminate the sources of pollution or hazards that damage either the environment or human and animal health. Environmental scientists are the stewards of our environment and are committed to keeping it safe for future generations. They:

- Conduct experiments with dyes to see how chemicals might disperse during a toxic spill.
- Evaluate how increasing human populations influence interactions between wildlife and people.
- Create maps and graphs showing air pollutants over time to help politicians make informed decisions.
- Monitor water quality at beaches, lakes, and rivers to detect contaminants and keep people safe.

A Bachelor of Science (BSc) degree is the minimum requirement to work in this field. This degree can be obtained at various universities throughout South Africa.

GEOSCIENTIST

Just as a doctor uses tools and techniques, like X-rays and stethoscopes, to look inside the human body, geoscientists explore deep inside a much bigger patient - planet Earth. Geoscientists seek to better understand our planet, and to discover natural resources, like water, minerals, and petroleum oil, which are used in everything from shoes, fabrics, roads, roofs, and lotions to fertilizers, food packaging, ink, and CD's. The work of geoscientists affects everyone and everything. They:

- Locate the safest place to build a new bridge in an area that is prone to earthquakes.
- Predict the next volcanic eruption, giving people who are in its path time to evacuate.
- Discover new ways to extract oil from rocks - needed for transportation, food, fabrics, plastics, and more.
- Find an underground water reserve that can be used to produce geothermal energy.

GEOGRAPHER

When you hear the word *geography*, you might think of maps and names of state capitals, but the work of geographers is much more than creating maps and identifying places. Geographers look at how people, places, and Earth are connected. They study the economy, social conditions, climate, and topography of a region to help answer questions in urban and regional planning, business, agriculture, and medicine. They:

- Define the terrain of another planet, so that engineers can design an exploration vehicle.
- Create up-to-the-minute fire maps to help fire-fighters combat a wildfire.
- Determine how and why the boundaries of a neighbourhood are changing.
- Create topographical maps to show how the coastline has changed over time.

METEOROLOGIST

The atmosphere is a blanket of gases, surrounding Earth that creates our weather. Meteorologists study the measurements and motion of the

atmosphere, and changing events within it, so that they can predict the weather. This weather forecasting helps the general public and people who work in industries such as shipping, air transportation, agriculture, fishing, forestry, and water and power better plan for the weather, and reduce human and economic losses. Meteorologists could be involved in activities such as:

- Monitor a drought so countries can make drought mitigation plans.
- Track a hurricane to alert people about its path, which could save thousands of lives.
- Develop the TV weather forecast to help people plan their daily activities.

IMPORTANT SCHOOL SUBJECTS

Mathematics and Physical Science as well as matriculation exemption

STUDY AT A UNIVERSITY

You need a BSc degree in meteorology to become a Meteorologist. A lot of people like to do the Honours degree too. Some even specialise in Aeronautical Meteorology Forecasting. The University of Pretoria is the only place in South Africa that offers all these options.

A meteorologist can work in *many different fields*, for example:



FORECASTER

The Central Forecasting Office in Pretoria gets weather information from around the world. The Forecaster then studies this data. From that, they predict the weather for that region.

BROADCASTER

Broadcasters analyse the weather patterns and report on the weather for television, radio etc.

RESEARCHER

Researchers study weather patterns for national weather bureaus, government and environmental protection agencies.

CLIMATOLOGIST

A Climatologist works for the Weather Bureau and collects and stores all the data in a databank. Seasonal studies on climate change have become increasingly important. This service is provided by the Weather Bureau and some other organisations (www.career-planet.co.za)

HYDROLOGIST

A hydrologist could be involved in the following:

- Gather and evaluate meteorological data to predict a drought.
- Help create environmentally responsible water usage regulations for communities along a major river.
- Collect and analyze water and mud samples to determine levels of pollutants in a water system.

Hydrologists are the people who study and manage water, one of our most significant and all-important resources. Through data gathered from satellite instruments, hydrologists examine and create computer models that show how water moves above, on, and under the earth. With these models, hydrologists work to conserve water, to predict droughts or floods, to find new water sources, and to reduce and reuse waste water.

IMPORTANT SCHOOL SUBJECTS

Mathematics, Physical Science, Biology and English are among the subjects that must be taken at school.

The School of Bioresources Engineering & Environmental Hydrology of the University of Kwazulu-Natal is one of the biggest offering study opportunities in the field of Environmental Hydrology.

For more information go to <http://saees.ukzn.ac.za/Homepage.aspx> or www.ukzn.ac.za



QUICK FACT

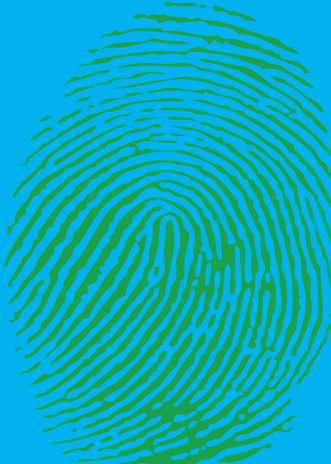
Did you know that although about 70% of the earth is covered in water, only 3% is fresh water? Of that 3%, approximately 77% is frozen. All water used at Mintek is analysed before being disposed of to ensure it meets safety and environmental standards.



PHYSICAL SCIENCE

FORENSIC SCIENTIST

Forensic scientists help to solve crimes by gathering and analysing physical evidence from crime scenes. Forensic science is a rapidly growing field, partly due to advances in technology which are creating more possibilities for research and specialisation. In South Africa, there is a dire shortage of trained forensic scientists. The result is that laboratories are struggling to get through their caseloads, causing ever-growing backlogs.



This career can be intense, bringing with it great challenges and rewards. Unlike in *CSI*, crimes are not solved in a matter of hours, great patience, dedication and concentration are required as laboratory work is painstaking and

can be monotonous. You'll definitely need an enquiring, scientific mind, skill in interpreting scientific results and critical thinking abilities. Good communication skills and confidence are needed for working with others and presenting findings in court.

If you think you have what it takes to pursue forensic science, you can look forward to a fascinating and rewarding career in which you will truly be making an important difference in the lives of others (www.sacareerfocus.co.za)

WHAT DOES THE WORK OF A FORENSIC SCIENTIST ENTAIL?

A forensic scientist could:

- Run ballistics tests on guns to find the one used in a bank robbery.
- Match DNA samples to reunite a long lost child with her family.
- Collect evidence from a crime scene to help understand the chain of events
- Solve a crime by matching fingerprints at the crime scene to a suspect

IMPORTANT SCHOOL SUBJECTS

Include Mathematics, Physical Science and Life Sciences

STUDY AT A UNIVERSITY

Possible *universities* to study at include the University of Johannesburg, University of Pretoria, the University of the Witwatersrand and the University of Cape Town (all BSc in Chemistry). Eventually, qualifications such as a BSc Honours majoring in Chemistry, Biology or Pharmacology, or a Masters or Doctorate are preferred.

WHERE CAN YOU WORK?

Forensic laboratories in the private or public sector or in private practice.

PHYSICIST

Physicists have a big goal in mind - to understand the nature of the entire universe *and* everything in it! To reach that goal, they observe and measure natural events seen on Earth and in the universe, and then develop theories, using mathematics, to explain why those phenomena occur. Physicists take on the challenge of explaining events that happen on the grandest scale imaginable to those that happen at the level of the smallest atomic particles. Their theories are then applied to human-scale projects to bring people new technologies, like computers, lasers, and fusion energy. They:

- Develop clean, unlimited fusion energy.
- Research maglev technology to prototype high speed trains.
- Design a laser to fix people's vision problems.
- Simulate a roller coaster ride on a computer.



CHEMIST

Everything in the environment, whether naturally occurring or of human design, is composed of chemicals. Chemists search for and use new knowledge about chemicals to develop new processes or products.

What can chemists do? They could:

- Develop a synthetic fibre that can stop a speeding bullet.
- Help discover new medicines that alleviate pain or cure diseases.
- Figure out how to make hair-styling gel work better.
- Discover new processes that could solve the world's energy crisis.

BSc IN CHEMISTRY (CHEMICAL BIOLOGY): AIMS OF THIS PROGRAMME OFFERED BY THE UNIVERSITY OF STELLENBOSCH

The purpose of this stream is to train you to become a scientist who has the necessary knowledge and skills for a career in those sectors of the chemical industry involved in the more organic and biochemical aspects of

chemistry. The stream will also prepare you for postgraduate studies and for a research career in Organic Chemistry and/or Biochemistry.

CAREER OPPORTUNITIES

There is a shortage in South Africa of well-trained chemists who are skilled in both Organic Chemistry and Biochemistry. Many large and small companies depend for their existence on chemists skilled in process control and in the quality control of raw materials and manufactured products. State laboratories, such as the forensic laboratories in Cape Town and Pretoria, SASOL, manufacturers of pesticides, manufacturers of cosmetic products and manufacturers of pharmaceutical products all offer career opportunities for chemists who are trained in these fields.

PROGRAMME LENGTH

The BSc degree can be obtained within three years and the BSc Hons in Chemistry and/or Biochemistry degree within another year of study.

School Subjects Required	Faculty of Science, University of Stellenbosch Department of Chemistry and Polymer Science		
Subjects	Level	Selection	NSC
Mathematics	6	Minimum selection mark (SM) of 65 %	National Senior Certificate (NSC) as specified by Umalusi
Physical Science	4	** Write the National Benchmark Test	
Afrikaans <i>or</i> English (Home Language <i>or</i> First Additional Language)	4		



FOCUS ON: ASTRONOMY

Astronomy is by far the oldest of the sciences. Ancient peoples without even a written language made a careful study of the motions of the sun and moon, in Africa and elsewhere, building stone temples and monuments tied to astronomical ideas. Babylonian and Greek astronomers were writing detailed mathematical descriptions of celestial motion more than 2000 years ago. Today's astronomers explore the nature of celestial objects ranging from planets and stars (including our own sun) to galaxies containing perhaps a million stars, clusters and much larger structures of galaxies, and the universe and its formation twenty thousand million years ago.

Astronomers want to understand the entire universe - the nature of the Sun, Moon, planets, stars, galaxies, and everything in between. An astronomer's work can be pure science - gathering and analysing data from instruments and creating theories about the nature of cosmic objects - or the work can be applied to practical problems in space flight and navigation, or satellite communications (www.sao.ac.za)

WHAT IS AN ASTRONOMER?

Astronomers are scientists who study the origins, evolution, and physical and chemical properties of objects that can be observed in the sky.

WHAT ASTRONOMERS DO

Astronomers work to increase our understanding of how the Universe began - how it has evolved and will evolve. They study how interstellar dust, gas clouds, planets, stars, galaxies and clusters of galaxies came to exist and how they work. To do this the only tools available are light, physics and mathematics.

Among other things, astronomers could do the following:

- Help plan a voyage to another planet or the moon and explain the mission to the public.
- Determine the composition of a planet, its atmosphere, and its moons.
- Investigate how galaxies are formed and if supermassive black holes live at their centers.
- Use sensitive radio telescopes to spot comets and asteroids with the potential to impact Earth.

UNDERGRADUATE STUDY

Universities that are offering undergraduate astronomy courses include the following:

Universities of South Africa (UNISA), Cape Town (UCT), Kwazulu-Natal (UKZN), Witwatersrand (Wits), Free State (UFS), Johannesburg (UJ), Western Cape (UWC), and Rhodes University (RU)

The University of the Free State (UFS) offers a BSc (Astrophysics) degree programme with Astronomy as compulsory subject with the following admission requirements:

School Subjects Required	Faculty of Natural and Agricultural Sciences, University of the Free State Department of Physics and Astronomy		
Subjects	Level	Selection	NSC
Mathematics	7	Minimum admission point (AP) of 30	National Senior Certificate (NSC) and matriculation exemption
Physical Science	4	** Refer to the UFS website and learning programmes for more information	
An official tuition language	4		
Life Sciences	5		

A typical undergraduate degree in astronomy would be a Bachelor of Science (BSc) degree in physics, mathematics or engineering.

CAREER OPPORTUNITIES

Graduates in astronomy are equipped to conduct research at the cutting edge of astrophysics and space science and have the broad science skills needed in any modern technological society. They would normally find employment at astronomical research facilities (Observatories), university departments and are also highly valued in fields as diverse as aerospace, financial services and telecommunication. Particularly appreciated are the astronomers' abilities in understanding basic scientific issues and in conceptualizing and evaluating systems-level solutions.

WHO CAN YOU CONTACT FOR MORE INFORMATION?

The South African Astronomical Observatory (SAAO) at (021) 447 0025

DID YOU KNOW?

The Southern African Large Telescope (SALT) is the largest single optical telescope in the southern hemisphere and among the largest in the world. It has a hexagonal primary mirror array 11 metres across, comprising 91 individual 1.2m hexagonal mirrors. Although very similar to the Hobby-Eberly Telescope (HET) in Texas, SALT has a redesigned optical system resulting in a larger field of view and effective collecting area.

SALT can detect the light from faint or distant objects in the Universe, a billion times too faint to be seen with the unaided eye - as faint as a candle flame would appear at the distance of the moon. The telescope and instruments are designed to operate from the near ultraviolet to the near infrared (320 to 1700 nm), and offer some unique or rare capabilities on a telescope of this size.

SALT is situated at the South African Astronomical Observatory (SAAO) field station near the small town of Sutherland, in the Northern Cape Province, and is ~380 km from Cape Town. SALT is funded by a consortium of international partners from South Africa, the United States, Germany, Poland, India, the United Kingdom and New Zealand. The construction phase was completed at the end of 2005 and from 2006 to 2009 it entered a period of commissioning and performance verification. Since September 2011, observing is now in full swing and the telescope is finally realising its huge potential as Africa's Giant Eye on the Universe (www.saa.ac.za)



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PERIODIC TABLE OF ELEMENTS

hydrogen 1 H 1.0079								
lithium 3 Li 6.941	beryllium 4 Be 9.0122							
sodium 11 Na 22.990	magnesium 12 Mg 24.305							
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.96	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91
caesium 55 Cs 132.91	barium 56 Ba 137.33							
francium 87 Fr [223]	radium 88 Ra [226]							
		rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [277]	meitnerium 109 Mt [268]	



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lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]

								helium 2 He 4.0026
			boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
			aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.38	gallium 31 Ga 69.723	germanium 32 Ge 72.64	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.798
palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29
platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
darmstadtium 110 Ds [271]	roentgenium 111 Rg [272]							

europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.05	lutetium 71 Lu 174.97
americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]	lawrencium 103 Lr [262]

BIOMEDICAL SCIENCES AND BIOTECHNOLOGY

Biomedical technology involves the analysis of, among other things, blood, sputum, urine, faeces and histological samples. As sophisticated instruments and techniques are used to analyse samples, a medical technologist must acquire a sound understanding of the procedures and a high level of competence, in order to perform the analyses accurately. Medical technologists work in different medical disciplines and usually specialize in one of his/her preferences, for example, Chemical Pathology, Haematology, Microbiology, Histology, Cytology, Virology, Blood Transfusion or Clinical Pathology.

IMPORTANT SCHOOL SUBJECTS

Mathematics, Physical Science and Biology
Each Institution has its own entrance requirements.

REGISTRATION

Registration as a qualified medical technologist takes place four years after registration as a student medical technologist, provided that the candidate has finished the first three academic years successfully. The candidate must also have worked in a laboratory approved by the SA Council of Medical Technology for at least 14 months and must have passed the examination of the Council.

QUALIFICATIONS AT A UNIVERSITY OF TECHNOLOGY

N Dip: Biomedical Technology
B Tech: Biomedical Technology
M Tech: Biomedical Technology
D Tech: Biomedical Technology

CAREER OPPORTUNITIES

Career opportunities for the medical technologist exist as company representative for medical and laboratory products or as research assistant, in government and provincial hospital laboratories, pathology institutions at universities, private pathology practices, the South African Institute for Medical Research, veterinary practices and several other industries, for example, pharmaceutical companies.

BIOTECHNOLOGIST

The biotechnologist or microbiologist is an innovative and confident person with an analytical mind. You will cultivate and identify various micro-organisms, study the appearance and activities of harmful and beneficial organisms in various industries and learn to manipulate micro-organisms to the benefit of man.

Diagnostics (termination of a disease through your knowledge) will form part of your work in the following disciplines:

Chemical pathology – The medical science and speciality practice concerned with all aspects of the disease, but with special reference to the essential nature, causes and development of abnormal conditions as well as the structure and functional changes that result from the disease processes.

Cytology – The study of chemistry of the cell, the anatomy, physiology and pathology

Hystopathology – The science or study dealing with the cytological and histological structure of abnormal tissue

Haematology – The medical speciality field related to the blood and blood forming tissues

Microbiology – The science concerned with microscopic and ultra-microscopic organisms



IMPORTANT SCHOOL SUBJECTS AND ADMISSION REQUIREMENTS

- Mathematics, Science, English and Biology.
- Each Institution has its own entrance requirements.
- One year experiential training at a training laboratory is needed.

QUALIFICATIONS AT A UNIVERSITY OF TECHNOLOGY

N Dip: Biotechnology
 B Tech: Biotechnology
 M Tech: Biotechnology
 D Tech: Biotechnology

CONSERVATION GENETICIST

What does the work of a conservation geneticist entail?

Among other things, a Conservation Geneticist studies species of animals which are in danger of becoming extinct and finds out why they only live in certain areas and how they are genetically related to one another. For example, a type of mole called “Juliana’s Golden Mole” is almost extinct and is only found in small numbers at three different places in South Africa.

A person like Paulette Bloomer, associate Professor in the Department of Genetics of the University of Pretoria and her colleagues in the Zoology department are finding out why only a few moles are left and what has caused this. She will also see if the three populations (groups) of moles at the three different locations are related. One of the populations may be completely lost because of urban development and Paulette will investigate to see what could happen if this group of moles is lost.

IMPORTANT SCHOOL SUBJECTS

Biology, Mathematics, Physical Science.

REQUIRED QUALIFICATIONS

BSc degree with Zoology, Botany, Genetics or Microbiology; BSc- Molecular & Cellular Biology/ Conservation Ecology/ Natural & Environmental Science/ Biotechnology (University)

WHERE CAN YOU WORK?

Research institutions, universities, National Zoological Gardens, diagnostic laboratories.

PLANT PATHOLOGIST

What does the work of a plant pathologist entail?

A plant pathologist studies micro-organisms and environmental conditions that cause plant diseases and recommends how these diseases can be managed or controlled.

Margareth Mahlangu, Quality Assurance and Food Safety Manager at the Johannesburg Fresh Produce Market is an expert in plant diseases, and has a background in microbiology (study of micro-scopic living things). Some micro-organisms cause food to spoil and others cause disease. Contamination with chemicals or pesticides can also make food unsafe. Her job at the Johannesburg Fresh Produce Market (JFPM) is to make sure that the fresh fruit and vegetables traded every day (average of 2700 tons) are safe to eat and of the highest quality.

IMPORTANT SCHOOL SUBJECTS

Biology, Mathematics, Physical Science

REQUIRED QUALIFICATIONS

BAgric/ BScAgric/ B Inst Agrar University)

WHERE CAN I GET A JOB?

Agricultural research organisations, universities, Department of Agriculture, retailers, agricultural consulting companies, diagnostic laboratories, biological control companies, seed and plant production companies.



BIOINFORMATICIST**What does the work of a Bioinformaticist entail?**

Bioinformaticists are usually experts in both biology and computer science. With this combined knowledge they develop new software to make sense of all the biological data that has become available. They can, for instance, find specific genes in bacteria and plants or other living things. For instance, Nothemba Kula, a Bioinformaticist at the South African National Bioinformatics Institute (SANBI), in Cape Town, is working with other bioinformaticists from around the world to find a way to cut out the specific stretch of DNA of the malaria parasite which causes the disease. If this was removed, it could reduce the number of people infected and dying from malaria (www.biocareers.co.za)

IMPORTANT SCHOOL SUBJECTS

Biology, Mathematics, Physical Science.

REQUIRED QUALIFICATIONS

BSc- Applied Biotechnology/ Biotechnology/ Biochemistry/ Microbiology/ Molecular & Cellular Biology or similar combined with a post-graduate university qualification in Bioinformatics or one of the national courses presented at the National Bioinformatics Network (University).

WHERE CAN I GET A JOB?

Various research organisations, universities, some pharmaceutical multinationals

IMMUNOLOGIST**What does the work of an immunologist entail?**

Patrick Bouic, an Immunologist at Synexa Life Sciences in Cape Town studies how the cells designed to protect humans against infections, work. To develop a vaccine against a specific disease, he has to find out how to trigger these protective cells to work before we get infected. A vaccine teaches our bodies to recognise disease-producing microbes. Patrick is also researching the immune activities of natural products, such as Buchu, a small indigenous shrub only found in the Western Cape, and how it can be used with man-made medicines to treat chronic diseases such as arthritis. His job at Synexa focuses on ensuring that the

biological products they make, are of a high quality and as safe as possible.

IMPORTANT SCHOOL SUBJECTS

Biology, Mathematics, Physical Science.

REQUIRED QUALIFICATIONS

BSc- Biotechnology/ Microbiology/ Molecular & Cell Biology/ Biological & Life Sciences and BSc Hons- Medical Cell Biology/ Immunology (University)

NOTE

You need an MSc (Immunology/ Medical Cell Biology) and/or PhD for higher positions in lecturing and research.

You need to register with the Health Professional Council of SA (HPCSA) to work with human blood and tissues.

WHERE CAN I GET A JOB?

Research organisations, universities, biotechnology start-up companies, large pharmaceutical companies.



VETERINARY VIROLOGIST

What does the work of a veterinary virologist require?

A person such as Theresa Smit, Virology Research and Development Manager at Onderstepoort Biological Products (OBP) in Pretoria, researches and develops new or improved vaccines against diseases of live-stock animals. A vaccine helps to stimulate the defence response of the body. It is usually a dead or weakened version of a micro-organism given to an animal to stimulate their bodies to make specific antibodies- but without causing disease. This means that if the animal is infected with the disease, it is able to resist and survive.

Onderstepoort Biological Products (OBP) makes millions of doses of vaccines per year that can be used to keep horses, cattle and sheep, healthy. Theresa ensures that the vaccines made are of the highest quality.

IMPORTANT SCHOOL SUBJECTS

Biology, Mathematics, Physical Science

REQUIRED QUALIFICATIONS

BTech- Veterinary Technology (University of Technology); BVSc; BSc- /Virology/Microbiology/Molecular Biology or similar, BSC (Hons) at a University

NOTE

You need an MSc or PhD (Research) or MMedVet or DVSc for higher positions in lecturing, research and management of laboratories or departments

WHERE CAN I GET A JOB?

Animal disease diagnostic laboratories, pathology laboratories, universities, agricultural research organisations, private animal vaccine producers such as Onderstepoort Biological Products (OBP).

INFORMATION TECHNOLOGY (IT)

The Information Technology industry is probably one of the most exciting industries world-wide. Rapid technological advances are propelling dramatic changes in the way computers are used to improve our lives.

Graduates have the opportunity to join this exciting industry. They can qualify themselves for a rewarding and incredibly stimulating career where they will have multiple career opportunities for many years to come.

Thousands of vacancies exist in South Africa and many IT professionals find employment outside our borders each year.

WHAT DOES THE IT SPECIALIST DO?

The person will find himself/herself in any of a wide variety of computerised environments. Responsibilities may include the maintenance of systems in use, systems analysis and design and/or programming of new systems, network administration, database administration and user support.

SYSTEMS ANALYST

The systems analyst studies the problems and needs of computer users and writes specifications for the computer system. He or she is also responsible for the detailed design of computer systems, which a programmer can convert into a computer language.

PROGRAMMER

The computer programmer is responsible for the detailed design of how the computer should perform a task and for instructing the computer accordingly. The programmer is the main interface between computer users and the computer itself.

COMPUTER TECHNICIAN

A computer is a complex collection of electronic and mechanical components and requires specific installation procedures, maintenance and repair, which is done by the computer technician.

WHERE DO I STUDY?

University

B Eng: Information Technology

A four-year engineering degree programme dealing with hardware, software, interfaces and networks, are available at various universities.

UNIVERSITY OF TECHNOLOGY

National Diploma: IT

A three-year National Diploma at the institution of Technology which includes one semester applicable in-service training.

B Tech: NDip plus one year study

COLLEGES

Nationwide Colleges such as CTI specialize in IT training

The courses are based on a self-paced study approach with instructors to assist and coach students whenever they may require assistance. Various diplomas such as Computer Science and Programming are available.

CAREER OPPORTUNITIES

The computer industry provides the fastest moving technology in modern industry. Computing skills are highly sought after, and the industry offers a high level of ongoing opportunities and challenges.

CAREER STATUS

IT specialists can acquire membership of the Computer Society of South Africa and the Information Technology Association (ITA)

Jack Manamela is an IT-Technician at the Faculty of Veterinary Science of the University of Pretoria. He says:

“I always loved technology when I was growing up, and that is why I chose to follow a career in Information Technology. It is a very challenging profession and very satisfying to work with computers. The good thing about my work is that I work with people every day. Everyone comes with

different ideas as technology is a wide field and it is very interesting to debate the differences in understanding. It makes life very easy when you have the relevant operating systems in order”.

REFERENCES AND SOURCES

<http://www.youthconnect.org.za>

<http://www.biocareers.co.za>

www.up.ac.za

www.uct.ac.za

www.ukzn.ac.za

www.nwu.ac.za

www.maties.com

www.wits.ac.za

www.ufs.ac.za

www.sao.ac.za

www.engenius.org.za

www.sci-bono.co.za

www.sawomaneng.org.za

www.saiee.org.za

www.merseta.org.za

www.careerhelp.co.za

www.saasta.ac.za

www.nstf.org.za

www.olympiad.org.za

www.exposcience.co.za

www.sansa.org.za

www.scifest.org.za



Discover Science

The Sci-Bono Discovery Centre is a world class interactive science centre that supports maths, science and technology education. We offer innovative, dynamic learning experiences for learners and teachers of all ages.

A strategic partner of the Gauteng Department of Education, Sci-Bono aims to:

- Improve teaching and learning of mathematics, science and technology in Gauteng schools
- Provide career education to all learners in Gauteng
- Promote and improve public awareness of and engagement with science and technology
- Be a premier family destination for local and international visitors.

Our collection of over 300 interactive science and technology exhibits caters for curious minds of all ages providing hours of fun for kids and adults.

For more information

visit us on www.sci-bono.co.za
or 011 639 8400

Miriam Makeba street, between Jeppe and President Streets, Newtown, Johannesburg



ENGINEERING IS ALSO FUN

Engineering can also be great fun. This is demonstrated by the autonomous robot vehicle (ARV) race annually organised by the Department of Electrical, Electronic and Computer Engineering at the University of Pretoria (UP). This much anticipated event is organised to showcase and celebrate the hard work and accomplishments of the University's Electrical, Electronic and Computer Engineering students.

The race involves small ARVs that are built by third year students as part of the Microcontrollers module (EMK 310) of their course. On Race Day, the students' ingenuity is put to the test when they compete against each other to see which team's ARV can complete a track made up of red, green and blue lines that zigzag across each other, in the shortest possible time.

Students work in teams of up to four to develop ARVs that can detect the different coloured lines on the track and navigate through it. At the start of the project in February every year, there are 60 teams of students, but only 52 teams make it through to eventually compete and put their creations to the test on the big day.

ARVs such as the ones built by the students are able to 'read' the track that they are supposed to follow by means of a light sensor that beams down onto the track, from where it is reflected back onto the sensor. The sensors are programmed to follow the green line, but as many of the students who take part in Race Day can attest, this is often much easier said than done as some of the cars seem to have a 'mind', or maybe a colour preference, of their own. During the race, the ARVs have three minutes to move from one end of the track to the other, during which time they are closely monitored by track officials and picked up and moved back onto the green line if they lose their way.

Although Race Day itself is mostly fun and games, the process of building the ARVs provides an excellent opportunity for students to integrate everything they have learnt in a practical way. Students are responsible for all facets pertaining to the design and construction of their cars, from writing, testing and implementing the firmware for the hardware that

has been designed, to building the chassis of the vehicle itself. The sensor system that is responsible for detection of the multi-coloured track for example, is partly developed in the Analog Electronics module, which students take concurrently with the Microcontrollers module in the first semester of their third year.

In addition to the obvious benefits that this innovative project holds for current engineering students, the Department also invites teachers and prospective engineering students from neighbouring schools to attend the event every year. Learners who register online and attend Race Day are treated to a tour of the Department's facilities and also have the opportunity to engage with the students taking part in the race, who explain the design and development of the robot cars so that the learners know exactly what is happening when the race starts, and hopefully become inspired to enrol for degree courses in Electrical, Electronic or Computer Engineering in the future.





The idea for Race Day and the project behind it is the brain child of Prof Tania Hanekom, who has received several awards, including a 2015 UP Innovation and Excellence in Teaching Award, for the innovative teaching methods that she has helped to implement in the Department over the years. According to Prof Hanekom, her main teaching philosophy involves challenging students, as this has proven to be an effective strategy for the development of excellence, especially in engineering students who cannot resist a competition that requires the application of their technical ingenuity with the added prospect of achievement. A second foundational philosophy, she says, is that excellence fosters excellence: if one wants to nurture excellence in students, one must offer excellence in the teaching and learning strategy – one needs to set an example that students cannot resist following.

Through this innovative project, aspiring engineers are guided through a carefully planned process that assists in developing a fundamental set of engineering skills, which include hardware and software design, systems integration, the ability to work and function in a team, time management, perseverance, and the good old indispensable 'engineering gut feeling', which comes only with experience in the execution of engineering projects. The pride and exhilaration shown by the teams of students when they compete in the race with a system that they developed from first principles as part of a team are truly rewarding and inspiring to see.

Article by Ansa Heyl, University of Pretoria

WOMEN IN THE FIELD OF ENGINEERING

INTRODUCTION

Despite certain existing perceptions, women have contributed to the diverse fields of engineering in modern and historical times. However, women are often under-represented in the fields of engineering, both in academia and in the profession itself.

Enrolment and graduation rates of women in post-secondary engineering programmes are very important factors in determining how many women go on to become engineers. Undergraduate degrees are acknowledged as the “latest point of standard entry into scientific fields.”

In 2011 the INWES Education and Research Institute (ERI), held a national workshop, the Canadian Committee of Women in Engineering (CCWE+20), to determine ways of increasing the number of women in the engineering field in Canada. The workshop identified a goal of increasing women’s interest in engineering by 2.6 percent by 2016 to a total of 25 percent through more incentives such as collaboration and special projects. A lack of early education was highlighted as one of the main obstacles in generating interest in addition to other factors, such as: “the popular culture of their generation, the guidance they receive on course selection in high school and the extent to which their parents, teachers and counsellors recognize engineering as an appropriate and legitimate career choice for women”.

Worldwide, a number of organizations and programs have been created to understand and overcome this tradition of gender disparity in the engineering profession. This is also the case in South Africa where the activities and aims of two organisations to promote the profession and assist in raising the profile of women in engineering and science will be specifically highlighted.

Before looking at these organisations’ roles though it is necessary to understand why it is important to also promote the profession among women, specifically in South Africa.

WHY DOES SOUTH AFRICA NEED WOMEN IN SCIENCE AND ENGINEERING?

The shortage of engineers is a global issue. However, Africa, including South Africa has a critical shortage of trained technological people. In 1980 North America had 2679 scientists and engineers involved in research and development per million population; Latin America had 251; Africa had only 49. In 1993, the USA had 7600 people per million involved in research and development and Japan had 7300. At the moment no reliable figures are available for Africa. Increasing the number of technologically trained people, both men and women, is essential for development.

It is crucial that the role of women in society must be developed and strengthened. Women have the greatest influence on the next generation. They set the standards for health and hygiene and they form the majority of the agricultural labour force. Here an old saying is applicable: “Educate a woman and you educate the next generation”.



THE IMPORTANCE OF TAKING SCIENCE SUBJECTS

According to the Association of South African Women in Science and Engineering, girls in Africa should be encouraged to take science subjects, not only those girls who might pursue a scientific or technological career, but also those who would then be enabled to apply scientific concepts in their daily lives. Taking science subjects should not only be seen as a vocation but as a means to develop the scientific and technological culture necessary for development.

Women are the greatest resource any country has. Providing encouragement and opportunity for girls and women in science and engineering is one of the most powerful ways of harnessing this resource for the development of our country. In a global economy with rising unemployment and a desperate need of scarce skills, increasing the number of women in engineering within any company or country is a competitive advantage. An increase in the number of female engineers not only assists with the critical skills gap but has further implications such as service delivery and adequate access to basic services. Women engineers provide value in creating products which are better suited to targeting 52% of the population who hold 80% of household purchasing power, namely women.

SOUTH AFRICAN ORGANISATIONS FOR WOMEN IN ENGINEERING

In South Africa, inspiring work has been done and is still being done by organisations specifically aimed at promoting the engineering profession among women and for women. Two organisations particularly worth mentioning are the Association of South African Women in Science and Engineering (SAWISE) and Women in Engineering or WomEng.

SAWISE – SOUTH AFRICAN WOMEN IN SCIENCE AND ENGINEERING

This Association is a dynamic organisation for all those who support the idea of strengthening the role of women in science and engineering in South Africa.

SAWISE aims to strengthen this role by inter alia:

- raising the profile of women scientists and engineers
- highlighting and addressing problems faced specifically by women in these fields
- lobbying for the advancement of women in science and engineering
- providing leadership and role models for young people wishing to enter the fields of science and engineering

An important function of SA WISE is to improve communication among women scientists and engineers, with e-mail being the preferred medium of communication. Members are encouraged to send ideas and information to SA WISE. SA WISE also maintains contact with other associations of women in science and engineering world-wide.

For more information please go to: <http://www.sawise.org.za/>



WOMEN IN ENGINEERING - WOMENG



Women in Engineering (WomEng), is a recognized non-profit organization working over the last 9 years to develop the next generation of engineering leaders in society. Through its proactive, needs driven bottom up approach, WomEng has been instrumental in developing strong female engineering talent channels. Historically, WomEng has run more programs in South Africa, with WomEng Kenya rolling out programs in 2014. This dynamic organisation is set to roll out in other countries, especially in Africa, as an appropriate solution to the skills needs on the continent. Together with its partners, the organisation will be sharing the invaluable lessons learnt in South Africa and packaging programs for other countries. Apart from developing a West African presence, WomEng is able to scale to other countries, including Turkey, Singapore and the United Kingdom, making it a truly global organisation.

The organisation's activities include engineering education to create awareness and raise the profile of the engineering industry, to attract and retain females into the engineering sector, and skills development.



WomEng has created a targeted set of interventions to attract, develop and nurture the next generation of women engineering leaders:

- GirlEng, which attracts high potential math and science students, nurtures and mentors them to enter the study of engineering
- The WomEng Fellowship is an annual technical innovation challenge for the best and brightest female engineering students to find solutions to global challenges and develop and prepare for industry
- @Network has created a platform for both male and female engineers to not only network but also engage in pertinent topics affecting the engineering industry, as well as looking for new opportunities
- Mentorship is the golden thread that ties all programs together and is a pivotal component in every program currently run at WomEng.

For more information please go to <http://www.womeng.org/>



WOMEN IN ENGINEERING'S HISTORY

The history of women in engineering predates the development of the profession of engineering. Long before women engineers were considered something special, some amazing women were doing great things to pave the way. Even before engineering was recognized as a formal profession, women with engineering skills often sought recognition as inventors. Although their contributions are sometimes unrecognized, women with a little ingenuity have always had the power to do great things. A look at a few of these profiles of historical women in engineering shows how they made a difference in their world.



HELEN AUGUSTA BLANCHARD

One of the greatest inventors of the industrial era

Helen Augusta Blanchard, founder of the Blanchard Overseaming Company was one of the greatest inventors of the industrial era. She was often referred to as "Lady Edison". She held 28 patents, 22 of which had something to do with sewing machines. She was born in 1840 to a wealthy family from Maine. When her family lost their fortune her mechanical skills came in handy. She filed her first patent for her most famous zigzag sewing machine in 1873. This zigzag stitch sealed the raw edges of the seam, which made the garment sturdier. Her 1873 zig-zagger is now on display at the Museum of American History in Washington, D.C. Other remarkable inventions by Blanchard are self-taking needles and a surgical needle. She died in 1922 at the age of 82.



OLIVE DENNIS

The engineer who changed the nature of railway travel and first female member of the American Railway Engineering Association

Olive Dennis was educated at Goucher College in Maryland and Columbia University in New York City. She later taught math in the Baltimore City schools for ten years. Dennis was the second woman to graduate from Cornell University with a degree in civil engineering. She also held a master's degree in math and astronomy from Columbia University. Finding work as an engineer was hard for Olive because she was a woman. Finally, in September 1920, she began work as draftsman in the engineering department for the Baltimore and Ohio (B & O) Railroad.

In November of 1921, Olive was designated as the engineer of service. This was mainly due to an effort to keep the support of female passengers as cars and intercity buses became more common. Her responsibility was to improve passenger service on the B & O.

For the next 30 years, Olive contributed to passenger comfort in various ways. She invented and held the patent for the Dennis ventilator, which was in the windows of passenger cars and could be controlled by passengers. She also played a major role in air-conditioning the coaches, dimming overhead lights, reclining individual seats, and creating stain-resistant upholstery.

Olive Dennis became the first female member of the American Railway Engineering Association. She is one of the most notable women in the railroad industry. She never felt gender stood in the way of advancement. Dennis's achievements noted her as a remarkable woman in her time and now.



EDITH CLARKE

The first woman to earn an Electrical Engineering degree from the Massachusetts Institute of Technology (MIT)

In 1908 Edith Clarke earned a bachelor's degree in mathematics and astronomy from Vassar College. After teaching physics at a girls' school for a few years, Edith decided to go back to school. She enrolled in the Massachusetts Institute of Technology and in 1918, earned her master's degree in electrical engineering. She was the first woman to receive a degree from that department.

From 1919 until her first retirement in 1945, Edith worked as an engineer for General Electric. In 1921, she received a patent for her "graphical calculator." This device was used to solve electric power transmission line problems. In 1926, Edith became the first woman to deliver a paper before the American Institute of Electrical Engineers. In 1947, Edith went to teach electrical engineering at the University of Texas, Austin. She was the first woman to teach engineering there. Edith's accomplishments was recognized in 1954 by the Society of Women Engineers Achievements Award "in recognition

of her many original contributions to stability theory and circuit analysis." Her inventions have made a difference in the world of electrical engineering and for women across the globe. She retired from teaching in 1956 and died in October 1959 at the age of 76.



MARTHA J. COSTON

The woman who developed signal flares that are still used by the U.S. Navy today

At the age of 21, Martha J. Coston found herself widowed and with four children to support. When her husband, a former naval scientist died, Martha found plans for a pyrotechnic (signal) flare in his notebook and decided that she could design a signal flare that would work. She faced two big challenges before she could come up with a design. First, the flares had to be simple enough to use in coded colour combinations. Second, they had to be bright, durable, and long-lasting so that they were effective tools for ship-to-ship and ship-to-land communications.

After several years of working on the design, Martha hit on the idea of using fireworks technology as the basis of her design. Once Martha thought of using fireworks technology, she developed the original plan into an elaborate system of flares called Night Signals. She received her patent for her Pyrotechnic Night Signals on April 5, 1859. The U.S. Navy then paid her \$20,000 for the patent rights to the flares. They also awarded Martha the contract to manufacture them. Martha's flares served as the basis of a system of communication that helped save

lives and win battles during the Civil War. Some historians have said that the signal flares helped the North to win the war.

After the war, Martha continued to improve her invention and came up with a twist-ignition device that she patented in 1871. The Coston Supply Company established by Martha Coston remained in business into the late 1970s. Martha sold her flares to navies, shippers, maritime insurance companies, and yacht clubs around the world like France, Italy, Denmark, the Netherlands, and Haiti. The system of bright, long-lasting signal flares revolutionized naval communication and continues to be in use. Coston's invention saved many lives. The effectiveness of Pyrotechnic Night Signals attracted the U.S. Navy and till now these devices are still used.

SOURCE:

<http://www.engineergirl.org/4356.aspx>

INTERESTING FACTS ABOUT THE HISTORY OF WOMEN IN ENGINEERING

- Hypatia of Alexandria (350 or 370–415 AD) is credited with the invention of the hydrometer
- In the 19th century, women who performed engineering work often had academic training in mathematics or science
- Ada Lovelace (1815–1852) was privately schooled in mathematics before beginning her collaboration with Charles Babbage on his analytical engine that would earn her the designation of the “first computer programmer”
- Alice Perry was the first woman in Europe to graduate with a degree in engineering in 1908 from Queen's College, Galway
- Elisa Leonida Zamfirescu (1887–1973) from Romania was one of the first female engineers in Europe who graduated from the Technical University of Berlin in 1912
- Georgia Tech in the USA began to admit women engineering students in 1952
- The École Polytechnique in Paris first began to admit women students only in 1972
- The number of BA/BS degrees in engineering awarded to women in the United States increased by 45 per cent between 1980 and 1994. However, from 1984–1994, the number of women graduating with a BA/BS degree in computer science decreased by 23 per cent.

(SOURCE: WIKIPEDIA)

MEET LINDIWE PRECIOUS ZONDO



During 2016 the South African office of Investec's advertising agency, global group Young & Rubicam launched a new brand campaign with two television commercials for the specialist bank.

The through-the-line 'Ambition' campaign houses 'Out of the Ordinary' stories of personal drive and a fierce sense of personal purpose.

The first television commercial, titled 'Promaths' which was released, portrayed the story of Sowetan-born Lindiwe Zondo, an alumna of Investec's Promaths programme, who went on to achieve a perfect score on her matric certificate at the Reasoma Secondary School for Mathematics and Physical Science to eventually graduate as an engineer from the University of Pretoria. The poignant and beautifully executed narrative follows a young Lindiwe through the use of a mathematic equation that pulls her struggles and ultimate triumph into perspective. Although her long commutes, late hours and problems with access to electricity result in 'minuses' and 'divisions', her ambition ultimately served as the most important factor in her eventual success.

Lindiwe's dedication to her studies has taken her from adversity to a budding engineering career. She graduated from the University of Pretoria in June 2015 with Mining Engineering as major. Currently and since September 2015, she is a Mining Engineering intern at Platinum Group Metals (RSA) (Pty) Ltd.

To become an engineer, Maths and Science are indeed not only necessary but also compulsory subjects. Lindiwe excelled in Maths and Science with the eventual exceptional achievement of scoring 100% for both those subjects in Matric. From 2008 to 2010 she was part of the Promaths programme, a partnership between Investec and the Kutlwanong Maths, Science and Technology Centre which supports high school learners to improve their performance in Maths and Science.

With regard to her experience with Promaths, Lindiwe says: “From the moment I started Kutlwanong classes I knew it was the right place for me. I have a love for Maths and Science and I felt like I was amongst people with the same interests, as me. It wasn’t just the classes. It was how you behaved as a professional, and the discipline. Our teachers told us that we were going to finish the syllabus in June and we did. Just because there was a norm of how to do things and how long it would take didn’t mean that we had to abide. I learned to set my own rules and to not follow the norm in terms of what I wanted to achieve.”

** Promaths is an Investec-funded project aimed at supporting the South African education system to produce students that are competent in Maths and Science. The programme provides extra tuition in Maths and Science to learners in Grades 10 to 12 at selected schools across the country. Investec currently funds six centres across the country. This year is particularly special as it marks 10 years since the establishment of Promaths in 2005. The programme has grown exponentially each year, and its success was crowned with a Mail & Guardian Investing in the Future STEM award in 2014.

Watch Lindiwe also on <https://www.youtube.com/watch?v=3iVH-KgE7jo> or

<https://www.liveoutoftheordinary.co.za/lindiwe?gclid=CI-w8pPT48wCFcG6Gwodcg4F3A#meet-lindiwe-zondo>

PUBLIC TVET (FET) COLLEGES CONTRIBUTE TO ENGINEERING SKILLS DEVELOPMENT IN SA

There are 50 Public Technical Vocational Education and Training (TVET) Colleges in South Africa that serve diverse communities and that are geographically widespread:

In order to assist in alleviating skills shortages in the country, the Colleges are offering NC(V) NQF Levels 2-4 in Engineering Studies: Information Technology and Computer Science; Engineering and Related Design; Electrical Infrastructure Construction, Mechatronics and Civil Engineering, and Building Construction.

These programmes comprise at least 60% practical and 40% theory. The practical experience is obtained in well-equipped practical workshops as well as placement for short periods of time in industry where experiential training is done.

The following N1-N6 Engineering Studies courses are being offered: Civil-, Electrical and Mechanical Engineering as well as Avionics. These courses had been re-introduced to assist in training Artisans and to improve the qualifications of those who had not yet obtained the minimum qualifications for acceptance to Apprenticeship.

The N1-N6 courses are offered per trimester (three times annually).

There are bursaries available from the Department of Higher Education and Training (DHET) ,but terms and conditions apply. Bursaries are available for N4-N6 courses and NC(V) programmes.



DHET TVET(FET) COLLEGES BURSARY SCHEME

WHO CAN APPLY?

New Application Level 2 NC(V) N1 Engineering and N4 Business Studies

- Only South African Citizens
- Registered or intending to register for an NC(V) programme/ N1 or N4 Engineering/ Business Studies
- Financially needy students with academic potential
- Evidence of good academic performance
- According to the admission policy and selection criteria of the College

WHO CAN APPLY?

Level 3 and 4/N2-N6

- Only South African Citizens
- Registration for an NC(V) programme/N2-N6
- NC(V) passed a minimum of five (5) subjects. N2-N6 passed a minimum of 3 subjects
- statement of results as evidence of good academic performance
- Financially needy students with good academic results will be considered
- According to the admission policy and selection criteria of the College

AIRCRAFT TECHNICIANS

Aircraft Technicians are responsible for the complete cockpit instrumentation and electronic systems of an aircraft. They are also responsible for the maintenance of electrical generation and distribution systems on the aircraft.

With further training an Aircraft technician (Avionics) will be able to diagnose and repair more serious faults and carry out more complex maintenance and inspection tasks.

AIRCRAFT MAINTENANCE

Aircraft maintenance workers perform preventative maintenance by inspecting aircraft engines, landing gear, instruments, pressurized sections and brakes.

Parts that appear worn are usually replaced or repaired in order to ensure they do not break while in flight. After all repairs are made, the aircraft must also be tested to ensure that it still works.



APPLICATION FORMS ARE AVAILABLE AT THE STUDENT SUPPORT CENTRES AT CAMPUSES.

The following documents and information must be provided:

- SAPS certified copies of Identity Document of applicant
- SAPS certified copy (ies) of Identity Documents of parent(s) or legal guardian(s), a letter of appointment must be provided or an SAPS sworn affidavit made by the guardian
- Certified copies of both Parents/Guardians/Spouse salary advise slips not older than three months from date of application (if applicable)
- Proof of address where studying
- SAPS certified copy (ies) of Death certificates if parent(s) / guardian(s) are deceased
- Residential addresses of applicant, parents / guardian must be provided; stands number, area, postal area name and a postal code (Water and Lights Bill or valid statement)
- Number of family members, age and educational status of members in the house hold
- Certified copies of both parents/ Guardian's pension payments not older than three months from date of application (if applicable)
- If a parent/guardian is unemployed-she/he must make an affidavit at the Commissioner of Oaths/SAPS (if applicable) –how they make a living
- Bursary Application form completed in full
- Proof of marital status if married, divorced or widowed (if applicable)
- New students supply Grade 9/10/11/12 statement of results); existing students supply academic history
- Proof of registration reflecting the number of registered subjects

PLEASE NOTE

- This is a 100% bursary, 0% loan, all bursary funds you are awarded with will not be paid back to the College or Government
- Bursaries are not guaranteed – terms and conditions apply. Such as: good excellent academic performance At least 100%-80% attendance of classes: the means test results and all applicable document submitted
- Students are responsible for paying the difference if not awarded the full funds

Admission requirements: N1- Grade 9/10; N1 for N2; N2 for N3
N4- Grade 12 pass with Mathematics and Science; N4 for N5 and N5 for N6

Duration: 11 weeks per N -level

Diploma requirement: 18 Months' practical experience related to field of study in the working environment

Faculty: Engineering Studies			
Civil Engineering			
N1-N3	N4	N5	N6
Mathematics	Building Administration	Building Administration	Building Administration
Building Science	Building Structural Survey	Building Structural Survey	Building Structural Survey
Building Drawing	Building Structural Construction	Building Structural Construction	Building Structural Construction
Bricklaying and Plastering Theory (N1 & N2)	Quantity Surveying	Quantity Surveying	Quantity Surveying
Plumbing (N1& N2)			
Woodworker's Theory (N1)			
Carpentry Theory (N2)			
Building and Civil Technology (N3)			

Career Opportunities: Architectural Technician; Quantity Surveyor; Drainage Inspector

QUANTITY SURVEYOR

Should be able to perform a wide variety of tasks throughout the complete life cycle of a construction project, cost control, and supervising staff.

TOWN AND REGIONAL PLANNER

Should be able to manage our towns, to encourage development for the purpose of economic growth while protecting our architectural heritage in local councils.

ARCHITECTURE

They will be able to plan, design and construct using the material forms of buildings which are often perceived as cultural symbols and as a work of art.

DRAINAGE SPECIALIST

They will be able to cover a wide range of projects from cleaning blocked pipes to a tank installation, after completing the job it must be rated to check the level of quality.

SANITATION AND RETICULATION

They must ensure that water is effectively utilized for domestic purposes and for livestock to farms through pipes and also to be responsible for the maintenance of toilet installations.

BUILDING CONSTRUCTION

Experience in civil works, earthwork, road works, building power line foundation work all over and management credentials. The must also have knowledge of safety and quality requirements to add value.



Admission requirements: N1- Grade 9/10; N1 for N2; N2 for N3
N4- Grade 12 pass with Mathematics and Science; N4 for N5 and N5 for N6

Duration: 11 weeks per N -level

Diploma requirement: 18 Months' practical experience related to field of study in the working environment

Faculty: Engineering Studies Electrical Engineering (Light Current)			
N1-N3	N4	N5	N6
Mathematics Engineering Science	Mathematics Engineering Science	Digital Electronics Communication Electronics Industrial Electronics	Digital Electronics Communication Electronics
Radio and Television Theory Industrial Electronics	Industrial Electronics Electro Technics Digital Electronics Communication Electronics	Electro Technics Power Machines Strength of Materi- als and Structures	Power Machines Strength of Materials and Structures Industrial Electronics Electro Technics

Career Opportunities: Industrial Engineering; Sound Technology; Theatre Technology; Process Lever Control; Digital Electronics; Instrumentation; Telecommunications

TECHNICAL THEATRE, DESIGN AND TECHNOLOGY

Will be able to prepare individuals to apply artistic and dramatic techniques to communicate their ideas and feelings through technical theatre methods including instruction in set design.

SOUND TECHNICIAN

Will be able to work behind-the-scenes of concert, plays or other live events and will be responsible for installing the sound and audio equipment.



Admission requirements: N1- Grade 9/10; N1 for N2; N2 for N3
N4- Grade 12 pass with Mathematics and Science; N4 for N5 and N5 for N6

Duration: 11 weeks per N -level

Diploma requirement: 18 months' practical experience related to field of study in the working environment

Faculty: Engineering Studies			
Electrical Engineering (Heavy Current)			
N1-N3	N4	N5	N6
Mathematics	Mathematics	Mathematics	Mathematics
Engineering Science	Engineering Science	Power Machines/ Strength of Materials and Structures	Power Machines/ Strength of Materials and Structures
Industrial Electronics	Industrial Electronics	Industrial Electronics	Industrial Electronics
Electrotechnology (N3)	Electro Technics	Electro Technics	Electro Technics

Career Opportunities: Computer Technician, Electronic Technician, Electrician

COMPUTER SYSTEM ENGINEERING

Will be responsible for designing and improving the hardware and software of computers to ensure that they operate efficient and work in a variety of sectors including telecommunication.

INFORMATION TECHNOLOGY MANAGEMENT

Will be able to work at IT firms, IT department that includes hardware engineers, software engineers, network engineers / architecture, as well as being a general manager.

DIGITAL ELECTRONICS

Will be able work as an electrical technician which will include fire detection systems, automatic docking systems, follow-up on logged help desk queries and perform quality audits for all the services.



Admission requirements: N1- Grade 9/10; N1 for N2; N2 for N3
N4- Grade 12 pass with Mathematics and Science; N4 for N5 and N5 for N6

Duration: 11 weeks per N -level

Diploma requirement: 18 Months' practical experience related to field of study in the working environment

Faculty: Engineering Studies Mechanical Engineering			
N1-N3	N4	N5	N6
Mathematics	Mathematics	Mathematics	Mathematics
Engineering Science	Engineering Science	Power Machines	Power Machines
Engineering Drawing	Mechanotechnics	Mechanotechnics	Mechanotechnics
Fitting and Machining Theory Or Welding Or Motor Trade Theory	Engineering Drafting and Design	Strength of Materials and Structures	Strength of Materials and Structures
		Mechanical Drawing and Design	Mechanical Drawing and Design



Career Opportunities: Mill Wright; Fitter and turner; Technical related career opportunities; Mechanical Technician; Power Station Worker; Mechanical Draughtsman; Welder; Tool making; Motor or Diesel Mechanic

MILL WRIGHT

It covers a broad spectrum integrating the combination of both mechanical fitting and electrical or electronic skills which include electrical installations, electronic controllers and micro processors such as those found in Computer Numerically Controlled (CNC) machines.

FITTER AND TURNER

Multi- skilled maintenance fitters are capable in most machining processes including turning, milling, grinding and welding which make them self-reliant in their trade. They are often involved in the development and fitting of new production processes.

TOOLMAKER AND JIG MAKER

The toolmaker and jig maker is a craftsman with the ingenuity to produce specialized jigs, fixtures and tooling to assist industries to produce their products consistently and accurately and with minimal waste. These people are skilled in the use of hand tools as well as grinding, turning, milling and drilling machines.

MECHANICAL DRAUGHTSMAN

Draughtsmen or draftsmen produce mechanical, technical and architectural drawings as well as maps. It is a highly technical career requiring excellent Maths Skills and attention to detail. It is now primarily done by computers by using a computer- aided design and drafting (CADD) system.

MECHANICAL TECHNICIAN

Duties include performing skilled work in several of the mechanical or building trades which may include work in the machinist, cabinet making, welding, electrical, and plumbing trades. A mechanical technician supervises the operation and maintenance of experimental equipment and repairs and maintains testing equipment and instruments.

MECHANIC

A mechanic is someone who specializes in the repair and maintenance of all types of vehicles. They are trained in the functioning of a car and its components such as the engine and brakes. The mechanic will conduct a thorough inspection of the vehicle and may conduct routine tests to check for any malfunctions. A mechanic will fix any problems by repair or replacement.

Compulsory Fundamental subjects in Business, Utility and Social Studies are:
English First Language, Mathematics and Life Orientation

**CIVIL ENGINEERING AND BUILDING CONSTRUCTION
NOF LEVELS 2-4 COMPULSORY VOCATIONAL SUBJECTS:**

LEVEL 2	LEVEL 3	LEVEL 4
Plant and Equipment	Plant and Equipment	Construction Planning
Construction Planning	Construction Planning	Construction Supervision
Materials	Materials	Materials
Carpentry and Roof work (specialisation)	Carpentry and Roof work (specialisation)	Carpentry and Roof work (specialisation)

Career Opportunities: It gives access to the following career sectors: Architectural Technology, Drainage Inspection, Industrial Designing; Quantity Surveying, Town and Regional Planning; Sanitation and Reticulation; Building Construction.

Vocational activities: Participate in the operation & maintenance of construction equipment & machinery; Participate in the construction of roads, bridges, dams; railways and buildings.

QUANTITY SURVEYOR

Should be able to perform a wide variety of tasks throughout the complete life cycle of a construction project, cost control, making valuable and supervising staff.

TOWN AND REGIONAL PLANNER

Should be able to manage our towns, to encourage development for the purpose of economic growth while at that time protecting our architectural heritage in local councils.



INDUSTRIAL DESIGNER

Will do freelance or self-employment, which is a huge opportunity for designers with appropriate industrial experience, it is an option that requires a network of contracts, good business sense and a determined attitude.

ARCHITECTURE

Will be able to plan, design and construct using the material forms of buildings which are often perceived as cultural symbols and as a work of art.

**Compulsory Fundamental subjects for all NC (V) Engineering Programmes are:
English First Language, Mathematics and Life Orientation**

**ELECTRICAL INFRASTRUCTURE CONSTRUCTION
NOF LEVELS 2-4 COMPULSORY VOCATIONAL SUBJECTS:**

Level 2	Level 3	Level 4
Electrical Principles and Practice	Electrical Principles and Practice	Electrical Principles and Practice
Workshop Practice	Electrical Workmanship	Electrical Workmanship
Electronic Control and Digital Electronics	Electronic Control and Digital Electronics	Electronic Control and Digital Electronics
Electrical Systems and Construction (Specialisation)	Electrical Systems and Construction (Specialisation)	Electrical Systems and Construction (Specialisation)

Career Opportunities: It gives access to the following career sectors: Electrical Construction Engineering; Industrial Engineering; Sound Technology; Theatre Technology; Process Level Control; Digital Electronics; Instrumentation.

Vocational Activities: Work as an electrician at an energy producing company or Power Plant; Work as an electrician at a telecommunications or private electrical installation company.

**Compulsory Fundamental subjects in Engineering Studies are:
English First Language, Mathematics and Life Orientation**

**ENGINEERING AND RELATED DESIGN
NOF LEVELS 2-4 COMPULSORY VOCATIONAL SUBJECTS:**

LEVEL 2	LEVEL 3	LEVEL 4
Engineering Fundamentals	Engineering Practice and Maintenance	Engineering Processes
Engineering Technology	Materials Technology	Professional Engineering Practice
Engineering Systems	Engineering Graphics and Design	Applied Engineering Technology
Fitting and Turning (Optional)	Fitting and Turning (Optional)	Fitting and Turning (Optional)
or	or	or
Engineering Fabrication (Optional)	Engineering Fabrication (Optional)	Engineering Fabrication (Optional)
Automotive Repair and Maintenance (Optional)	Automotive Repair and Maintenance (Optional)	Automotive Repair and Maintenance (Optional)

Career Opportunities:
Depending on **specific career** field chosen:

FABRICATION:

The certificate holder will be able to design shafts and ventilations systems; plan and design mines and mining facilities; fabricate plate work and manufacturing of steel structures; interpret technical drawings.

FITTING AND TURNING:

The certificate holder will be able to manufacture tools, machines and engines; operate and maintain machines; manufacture machines and other related components; interpret technical drawings.

AUTOMOTIVE REPAIR AND MAINTENANCE:

The certificate holder will have access to the following sectors: Car manufacturing; Automotive Repair and maintenance; Motor Mechanics.



ORBIT TVET COLLEGE

ORBIT College is one of 50 public Technical Vocational Education and Training (TVET) Colleges in South Africa, that specializes in priority skills development. We are situated in the North West Province with campuses in Rustenburg, Brits and Mogwase.

WE OFFER A VARIETY OF PROGRAMMES

BUSINESS STUDIES

National Certificate Vocational (NCV)

Finance, Economics and Accounting
Office Administration
Management
Transport and Logistics

Report 191 (NATED N4-N6)

Human Resource Management
Business Management
Financial Management
Management Assistant

ENGINEERING & IT STUDIES

National Certificate Vocational (NCV)

Civil Engineering Construction
Electrical Infrastructure Construction
Engineering and Related Design
Information Technology and Computer Science

Report 191 (NATED)

Electrical Engineering (N1-N6)
Fitting and Turning (N1-N6)
Boilermaking (N1-N6)
Motor Mechanic (N1-N3)

GENERAL STUDIES

National Certificate Vocational (NCV)

Hospitality
Tourism

Report 191 (NATED N1-N^)

Hospitality and Catering Services
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- . N2 Certificate with trade theory and 3 years' relevant work experience
- . Technical trade theory programmes quality-assured by a SETA and a minimum of 3 years' relevant work experience (NQF Level 3)
- . Relevant National Certificate (Vocational) Level 3 Engineering qualification and 3 years' relevant work experience
- . Relevant National Certificate (Vocational) Level 4 Engineering qualification and 18 months' relevant work experience
- . Technical Grade 12 with Mathematics, Engineering Science and related trade theory subject and 3 years' relevant work experience
- . Grade 9 and a minimum of 4 years' relevant work experience
- . Relevant (directly related to the trade theory subjects) N6 Certificate or National Technical Diploma (S.T or N stream) and 18 months' relevant work experience

CENTRE OF SPECIALISATION (CoS)

CoS programmes ensure a closer working relationship with industry, training centres and the Post School and Training Sector. The curriculum offered consists of occupational qualifications designed by industry, for industry and are registered with the Quality Council for Trades and Occupations (QCTO).

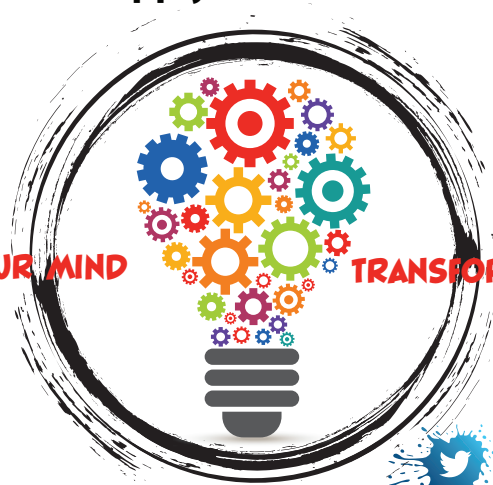
ORBIT TVET College specializes in two apprenticeships namely: Electrical Trade offered at Brits Campus and Diesel Mechanic Trade offered at Mankwe Campus

FINANCIAL ASSISTANCE (Ts & Cs apply)

- . NSFAS bursaries for NCV & Report 191 are awarded according to the NSFAS bursary guidelines
- . College bursaries are awarded according to the College bursary administration rules and regulations as outlined in the Student Support policy

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**Compulsory Fundamental subjects in Engineering studies are:
English First Language, Mathematics and Life Orientation**

**INFORMATION TECHNOLOGY AND COMPUTER SCIENCE
NOF LEVELS 2-4-4 COMPULSORY VOCATIONAL SUBJECTS ARE:**

Level 2	Level 3	Level 4
Introduction to Information Systems Introduction to Systems Development Electronics Entrepreneurship;	Computer Hardware and Software Principles of Computer Programming System Analysis and Design Project Management	Computer Programming Data Communication and Networking System Analysis and Design Project Management

Career Opportunities: The certificate holder will have access to the following career sectors: Computer Programming; Information Technology Management; Computer Systems Engineering and Data Processing.

DATA PROCESSING

Will be able to program survey, prepare data, process data, process data and manage data project associated deliverables, data entry scripting, quality assurance and project communication to perform data validation to access data quality before analysis.

INFORMATION TECHNOLOGY MANAGEMENT

Will be able to work at an IT firms, IT department that includes hardware engineers, software engineers, network engineers / architecture etc. as well as being a general manager.

DIGITAL ELECTRONICS

Will be able work as an electrical technical will include fire detection system, automatic docking system, follow-up on logged help desk queries and perform quality audit for all the services.

COMPUTER SYSTEM ENGINEERING

Will be responsible for designing and improving the hardware and software of computers to ensure that they operate efficient and work in variety of sector including telecommunication.

GRADUATE WITH A 100% EMPLOYMENT RATE IN THESE WORLD-CLASS ICT PROGRAMMES:

SOFTWARE ENGINEERING
(SYSTEM ARCHITECT, SOFTWARE DESIGNER)

SOFTWARE DEVELOPMENT
(APP DEVELOPER, USER EXPERIENCE DESIGNER)

INFRASTRUCTURE
(NETWORK ADMINISTRATOR, SECURITY ANALYST)

DATA SCIENCE
(DATA ANALYST, BIG DATA SPECIALIST)

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Always putting the needs of our **students first**, DUT aims to shape the future generations through **teaching, learning and research – improving lives and livelihoods** through many initiatives like our **undergraduate scholarship** for new and returning students which includes a **50-100% remission of tuition fees**, should students achieve **an average aggregate of 70%**.

READY TO REACH **YOUR FULL POTENTIAL?**

Join **over 34 830** students currently enrolled across **DUT's 7 campuses** and say yes to success with higher education excellence but remember, we have a large prospective student base which brings many challenges in terms of student accommodation, which is why **we encourage all students to apply for student housing early** or make alternate accommodation arrangements.

Students who require financial aid, undertaken by the National Student Financial Aid Scheme (NSFAS), should also remember to apply directly to NSFAS.

VISIT **WWW.DUT.AC.ZA** TO FIND OUT MORE INFO

Applications need to be done via the Central Applications Office (Application dates vary)

031 373 2000 (DBN) • 033 845 8800 (PMB) • info@dut.ac.za



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* Candidate for Accreditation of specific programmes.

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MECHATRONICS

Minimum entry requirements to the programme

For entry into the National Certificate (Mechatronics) at NQF Level 2, you require:

- A year end school report for Grades 9, 10, 11 or 12 certificate; or
- An NQF Level 1 qualification; or
- An approved bridging programme designed for the specific purpose to access NQF Level 2; or
- A Recognition of Prior Learning (RPL) assessment to meet the basic requirements for access to NQF Level 2

LEVEL 2	LEVEL 3	LEVEL 4
Introduction to computers Electrotechnology Manual Manufacturing Mechatronic Systems	Stored Programmes Systems Electrotechnology Machine Manufacturing Mechatronics Systems	Stored Programme Systems Electrotechnology Computer-Integrated Manufacturing Mechatronic Systems

WHAT ARE THE CAREER OPPORTUNITIES AFTER COMPLETING THE NATIONAL CERTIFICATE (MECHATRONICS):

The National Certificate (Mechatronics) provides an opportunity to access careers in any of the sectors listed below:

- Mechanical Engineering
- Electrical Engineering
- Pneumatics
- Hydraulics
- Robotics
- Programmable Logic Control (PLC)
- Computer Numeric Control (CNC)
- Industrial Information Technology
- Welding



CAREER INFORMATION

Oversee the work of contractors in accordance with project requirements; Design engineering systems for the automation of industrial tasks; Create mechanical design documents for parts, assemblies or finished products; Design advanced electronic control systems for mechanical systems; Maintain technical project files; Create embedded software design programs; Analyze existing development or manufacturing procedures and suggest improvements; Implement or test design solutions and select material appropriate for mechatronic system designs.

Research, design, develop or test automation, intelligent systems, smart devices or industrial systems control.

IF YOU SEE MONEY DIFFERENTLY.

COME MAKE A DIFFERENCE
WITH US.

Apply for the Nedbank External Bursary Programme.
Be a #YoungDifferenceMaker



AT NEDBANK WE BELIEVE IN USING OUR FINANCIAL EXPERTISE TO DO GOOD BY ASSISTING BRIGHT YOUNG LEADERS TO PURSUE THEIR ACADEMIC DREAMS.

The Nedbank External Bursary Programme aims to fund academically deserving students who do not have the financial means to study fulltime towards a first undergraduate degree or diploma at a South African public university or university of technology. Bursaries are awarded to address scarce and future skill requirements in the financial sector as well as for South Africa.

CRITERIA FOR SELECTION:

Only applications from South African citizens will be considered.

Applicants must have a proven financial need.

Past academic results:

- A minimum academic average of 65% in the year that you are applying, ie grade 12 or university level.
- A minimum academic average of 65% for the subjects you plan to study at university.
- Applicants studying Mathematics Literacy will not be considered.

Successful admission approval to a South African public university or university of technology for an undergraduate qualification.

DOCUMENTS REQUIRED FOR APPLICATION:

- Valid South African Identity Document.
- Most recent academic transcript.

DOCUMENTS REQUIRED FOR SHORTLISTED APPLICANTS:

- Proof of income of parents/guardians, ie payslips.
- Social Grant advices.
- Affidavit in the case of unemployment.
- Income and expenditure statement of parents/guardians.
- Death certificate of parent(s), if applicable.
- Divorce certificate of parent(s), if applicable.

THE APPLICATION PROCESS:

Bursary applications are screened against the Nedbank External Bursary selection criteria, and bursaries are awarded at The Nedbank Education Trust's sole discretion.

SHORTLISTED CANDIDATES WILL BE REQUESTED TO:

- submit the relevant documents for a financial review;
- participate in psychometric and other assessments; and
- attend an interview.

Please refer to www.nedbank.co.za/bursary for more information on external bursary opening and closing dates and to apply online.

All candidates will receive **feedback on the status** of their application by **end November 2020**.

Contact information:

Unlockyourambition@nedbank.co.za

Bursaries are granted at Nedbank's sole discretion.