SCIENCE, ENGINEERING AND TECHNOLOGY COURSES
Contents

Company Overview 3
Introduction 4

Asset Management 6
Programme in Asset and Maintenance Management 6

Cost Management 6
Realistic Cost Decision-Making 6

Energy 7
Energy Conservation and Industrial Resources Management 7
Power Plants (Fossil, Gas, Nuclear) 7
Renewable Energies 8
Solar Energy Engineering 8
Porous Flow (Applications, Theory, Design Experiment) 9
Renewable Energy: Distributed Generation 9
Nuclear Reactor Materials 10

Engineering Management 10
Programme in Engineering Management 10
Non-Destructive Testing (NDT) for Engineers 11

Forensics 11
Forensic Toxicology 11

Maintenance Management 12
Programme in Maintenance Management 12
Maintenance Management 12

Metallurgy 13
Principles of Pyrometallurgy 13
Mechanical Metallurgy 13
The Extractive Metallurgy of Zinc 13
Mathematical Modelling of Metallurgical Processes and Materials 14

Mining 14
Engineering Geological Site Investigation Techniques 14
Global Minerals Industry Risk Management 15
Strata Control for the SHEC Mineral Resources Industry 15
Programme in Blasting Engineering 16
Mine Ventilation Engineering for the SHEC Mineral Resources Industry 16

Occupational Hygiene Module for the SHEC Mineral Resources Industry 17
Basic Coal Preparation 17
Advanced Coal Preparation 18

Railway Engineering 18
Introductory Multi-Disciplinary Concepts in Railway Engineering 18
Wheel Rail Interaction (WRI) 19
Railway Infrastructure Maintenance Management 19
Track Geotechnology 20
Locomotive Systems, Performance and Maintenance Management of Continuously Welded Rails 20
Introduction to Railway Projects and Processes 21
Railway Asset Management 22
Railway Safety Investigation 22

Signal Processing and Wiring 23
Practical Wiring 23
Practical Wiring and Signal Processing for Electrical Engineers 23

Spreadsheets 24
Spreadsheets as an Engineering Tool 24
Systems Engineering 24

Systems Engineering Management 24
Requirements Engineering 25
Systems Design 26
Programme in Systems Engineering 26

Water 27
Pipeline Design, Operation and Maintenance 27
Centrifugal Pump Sizing 27
Company overview

Having played a profound part in the history of South Africa for more than 100 years, the University of Pretoria boasts a lasting legacy that endures through a cluster of innovative and multidisciplinary Training Solutions and Research Solutions rendered through Enterprises University of Pretoria (Pty) Ltd.

Our Training Solutions and Research Solutions translate to increased productivity, enhanced customer service excellence and improved profitability within any industry. Drawing on the knowledge of academic and industry experts from the University of Pretoria, our track record includes high-quality, customised and practical solutions that set us apart from the traditional skills development and research organisation.

With some of South Africa’s most acclaimed academics and thought leaders on our teams of research specialists and course leaders, we ensure that our clients continuously engage in groundbreaking knowledge transfer – shifting knowledge to insight.

TRAINING SOLUTIONS

We offer the best possible Training Solutions to organisations and individuals through career-focused short courses that provide proactive, relevant responses to the skills development needs identified in various industry sectors, places of work, communities, the country, and beyond.

Already having made a significant impact on the careers of more than 320,000 individuals from across the globe, we are taking our commitment to lifelong learning even further. Not only do we offer a selection of more than 300 short courses across 20 industry fields, we also provide a choice of training options that include scheduled courses, Continued Professional Development (CPD) courses, online and blended learning interventions and customised corporate training solutions.

Scheduled courses

Our scheduled courses are specifically designed to meet the training needs of our broader communities and are open to all prospective delegates throughout the year. In fact, at any given time we schedule in excess of 100 courses during a three-month period. This affords delegates and opportunity to pursue a variety of industry-related short courses, while being able to plan ahead and reap the benefits of workplace and professional skills development.

CPD courses

We offer various CPD courses, activities and seminars for engineers, educators, veterinarians and medical professionals, among others, who need to continuously update their knowledge, acquire CPD points and maintain their professional status through their respective professional bodies. We also offer online CPD activities that cover various topics and include online tests, assessments and quizzes that can be completed towards CPD points.

Professional Online Development (PODs)

By recognising that many professionals would like to continue honing their knowledge and skills, but often struggle to find the time to attend formal lectures, we provide intensive, collaborative and focused online or blended learning opportunities that can be accessed anywhere, at any time. Integrated under the University of Pretoria’s Professional Online Development (PODs) offering, our online training options include Open Educational Resources (OERs), online short courses, open online courses and online CPD.

Customised corporate solutions

In an effort to address identified industry- or sector-specific training needs, our customised in-house course options are geared towards organisations that need to upskill and develop their staff accordingly. We can design a basic course to introduce newly appointed staff to a specific topic, or provide specialised training to an executive committee on thought-leading management and leadership issues. All these courses can be presented on one of the various University campuses, any suitable venue or on-site.

RESEARCH SOLUTIONS

We are also in the unique position to offer our clients Research Solutions to help us better serve them as an add-on to our wide range of short courses. We facilitate research projects to clients through personalised services and innovative business solutions that are conducted by specialised project teams.

Our focus areas include, among others, engineering and construction, sensory research and food product evaluation, economic modelling, statistical data mining solutions, agribusiness and actuarial risk management solutions and client retention strategies – with close to 400 projects successfully completed in 2014 alone.

WE ARE PART OF A GLOBAL COMMUNITY

In pursuit of international markets for the extension of our business activities and services across the world, we have adopted a proactive approach in acquiring new business partnerships on the African continent (and beyond) for the successful execution of various training and research projects.

In 2014, delegates from 56 different countries (of which 37 are on the African continent) registered for scheduled short courses, while a total of 170 different courses were attended by international delegates. Other international activities included 69 research projects for 42 clients in 25 countries, and the collaboration with 29 universities and other academic institutions.

ACCREDITATION, CERTIFICATION AND OWNERSHIP

Enterprises University of Pretoria (Pty) Ltd is wholly owned by the University of Pretoria. The University is registered as a multipurpose, public training provider in the higher education and training band. Delegates who successfully complete a course and comply with the related assessment criteria are awarded certificates by the University in recognition of their professional skills development.

We are also registered as a service provider with and member of a selection of national and international organisations and professional bodies through which we can deliver business insight beyond the academic realm that not only showcases market relevance, but also suits clients’ unique organisational and industry needs.

Enterprises University of Pretoria is a level 2 contributor to broad-based black economic empowerment (B-BBEE).
To register online visit www.enterprises.up.ac.za
We have various Science, Engineering and Technology short courses that not only promote skills uptake, but also provide you with sound knowledge of management, finances and marketing within the field.

With proudly South African scientific breakthroughs and engineering marvels like Pratley Putty and the Creepy Crawly being used worldwide, South Africa has a strong legacy of innovators in the Science, Engineering and Technology industries. A fundamental challenge and often culture shock for the young engineer or scientist, however, is to achieve results via people, not by individual brilliance alone.

We bridge this gap through various courses that updates you (as technical specialist) about the establishment and management of a sustainable value chain, technology and project management, maintenance and also asset management within the mining, energy and metallurgy industries among others.

Our CPD courses are recognised by professional bodies such as the Engineering Council of South Africa (ECSA).
Asset Management

Programme in Asset and Maintenance Management

Course number: P000699

The overall objective for training in asset management is to provide an integrated understanding of the complementary disciplines applicable to the management of physical assets. This Programme in Asset and Maintenance Management provides delegates with an awareness of the collaboration that is required and the application of cross-disciplinary skills in technical, engineering, finance, logistics, human communications and other functions to achieve the effective management of physical assets.

Course content:
- Physical asset management principles and practices
- Principles of maintenance management
- Maintenance approaches and strategies
- Financial management
- Condition-based maintenance
- Decision and risk management
- Operations management
- Advanced asset management

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Cost Management

Realistic Cost Decision-Making

Course number: P002461

Demonstrating the use of mathematical techniques to be able to make optimal decisions regarding costs, this short course in Realistic Cost Decision-Making focuses on time-value of money and what it really means – coupled with realistic interest rates, choosing between different units/projects/ventures, decision-making under budget constraints, different interest rates in project life-time, decisions on when to repair or to replace, public utilities decision-making, and uncertainty, parameter sensitivity and risk.

Course content:
- Time-value of money and what it really means coupled to realistic interest rates
- Choosing between different units/projects/ventures
- Decision-making under budget constraints
- Different interest rates in project life-time
- Decisions on when to repair or to replace
- Public utilities decision-making
- Uncertainty, parameter sensitivity and risk

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

To register online visit www.enterprises.up.ac.za
Energy Conservation and Industrial Resources Management

Course number: P001635
The short course in Energy Conservation and Industrial Resources Management focuses on the principles of the smallest temperature approach (pinch) that were recently further extended to other industrial, environmental considerations, and the like. It should be applied whenever capital investment is considered as it results in resources such as water, hydrogen, oxygen, CO2 emissions, fluid gas, combined heat and power, and batch processing process designs with lower energy use that are better integrated into the entire site energy system.

CPD: ✔️

Course content:
• Pinch technology: thermal pinch analysis
• Water pinch
• Flue-gas pinch
• Oxygen pinch
• Combined water-oxygen pinch analysis for better management of centralised and distributed wastewater treatment systems
• Combined thermal/mass transfer pinch analysis (saving water by saving energy, considering evaporation and condensation)
• Experience in pinch technology application for power production
• Workshop on pinch technology using supertarget

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Power Plants (Fossil, Gas, Nuclear)

Course number: P003020
Power generation is one of the most important industries in any country. This short course in Power Plants (Fossil, Gas, Nuclear) gives an introduction on how power can be generated in different power plants, focusing on power generation in different industries (including fossil-fuel plants, gas-turbine plants and nuclear plants). Delegates will discuss a fast review of thermodynamic cycles and be given an explanation of each type of power plant.

Course content:
• Fast review of thermodynamic cycles
• Classification of power plants (fossil, gas and nuclear)
• Explanations of each kind of power plant

(Note: Upon request of clients’ specific needs, the weighting in focus of the course could be adapted.)

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Renewable Energies

Course number: P003021

Renewable energy refers to any type of energy that comes from natural resources, such as sunlight, wind, rain, waves and geothermal heat. Due to environmental issues and high oil prices, the support and investment on renewable energies by governments are increasing. This short course in Renewable Energies focuses on the mechanism and application of all renewable energies from solar, wind, ocean and biomass energy to geothermal heat, biofuel and hydropower energy.

Course content:
- Fluid mechanics, heat transfer, solar energy and chemistry
- Wind, ocean and biomass energy
- Geothermal heat
- Biofuel
- Hydropower

(Note: Upon request of clients' specific needs, the weighting in focus of the course could be adapted.)

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Nanofluids (Applications, Characteristics, Governing Equations, Advantages, Preparation, Safety Issues)
Course number: P003022

The technological advantages offered by nanofluids (the suspension of nanometer-sized particles in a conventional heat-transfer fluid base) are the driving force behind nanofluids research. They have been experimentally shown to enhance heat transfer, which, in turn, allows the size of heat transfer systems to be reduced. This short course in Nanofluids focuses on the importance of the application of nanofluids, including the characteristics, governing equations, preparation and safety issues with regard thereto.

Course content:
- Fluid mechanics and heat transfer
- Applications and characteristics of nanofluids
- Governing equations
- Advantages, preparation and safety issues
- Design experiments

(Note: Upon request of clients' specific needs, the weighting in focus of the course could be adapted.)

Admission requirements:
Prospective delegates should at least have a National Senior Certificate (Grade 12).

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Solar Energy Engineering

Course number: P003023

This short course in Solar Energy Engineering introduces and analyses different solar-thermal systems in terms of applicable heat transfer and thermodynamics principles. The main focus of the course includes sun-earth geometrical relations, solar radiation, energy requirements in buildings, energy storage, heating and cooling processes, bulk solar thermal power generation systems, life-cycle costing, and large-scale plant specifics and quantification.

CPD: 

Course content:
- Heat transfer, fluid mechanics and thermodynamics
- Sun-earth geometrical relations
- Solar radiation
- Energy requirements in buildings
- Energy storage
- Heating and cooling processes
• Bulk solar thermal power generation systems
• Life-cycle costing
• Large-scale plant specifics and quantification

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Porous Flow (Applications, Theory, Design Experiment)

Course number: P003024
Transport through porous media has raised considerable attention in recent decades due to its relevance in a wide range of applications. This short course in Porous Flow provides an introduction to the physical models that are used in the study of fluid flow and heat transfer in porous materials. Delegates will get an understanding of the transport mechanism, including a review of conservation laws, mechanics of fluid flow, heat transfer, forced convection and natural convection through a porous medium, and design experiments.

Course content:
• Conservation laws
• Mechanics of fluid flow through a porous medium
• Heat transfer through a porous medium
• Forced convection through a porous medium
• Natural convection through a porous medium
• Design experiments

Admission requirements:
Prospective delegates should have a relevant bachelor's degree in Engineering with specialisation in the fields of chemical, civil, computer, electrical, electronic, industrial, mechanical, metallurgical or mining.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Renewable Energy: Distributed Generation

Course number: P003316
The short course in Renewable Energy: Distributed Generation covers the fast-growing field of wind and photovoltaic (PV) technology in detail. This course also briefly covers other renewable energy (RE) technology (such as small hydropower systems, concentrating solar power (CSP) technologies, biomass, etc.) Delegates will discuss the benefits, technical issues, design and use of renewable distributed generation including wind, PV and hybrid systems in the power generation industry.

CPD: ✔

Course content:
• Benefits of Distributed Generation (DG)
• DG technologies
• Isolated and grid-connected DG systems
• Voltage fluctuations, fault level and stability DG integration issues
• Wind power systems
• Photovoltaic (PV) systems
• Other renewable energy technologies

Admission requirements:
Prospective delegates should at least have a National Senior Certificate (Grade 12).

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Nuclear Reactor Materials

Course number: P002214

This short course in Nuclear Reactor Materials addresses the mechanical behaviour of metals at room and high temperatures with a special emphasis on nuclear materials that are used in power reactors. In particular, these materials’ behaviour under irradiation for in-core materials, as well as the unique environmental conditions for out-of-core materials, are covered. Delegates will be able to interpret the deformation behaviour of metals and alloys for the correct design and application in nuclear reactors.

CPD: ✓

Course content:
- Introduction to the main failure mechanisms of nuclear components
- Elastic and plastic stress strain behaviour
- Uses of texture in Zircaloy cladding
- Dislocations and the deformation of metals under normal and irradiation damage conditions
- Engineering strengths and deformation with reference to nuclear application (i.e. steam generators)
- Corrosion of materials in nuclear systems (including stress corrosion cracking, oxidation and hydride formation in Zircaloy)
- Creep deformation and rupture under normal and irradiation conditions
- Fracture mechanics with an emphasis on Reactor Pressure Vessels
- Surveillance programmes
- Fatigue failure under normal and under nuclear reactor conditions
- Failure analysis methodology plus a number of case studies

Admission requirements:
Prospective delegates should have a relevant bachelor’s degree in Engineering (metallurgical, mechanical, chemical or industrial), a BTech (metallurgical or mechanical) or any other relevant Science-based tertiary degree where delegates are/were exposed to materials application and development in general.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Engineering Management

Programme in Engineering Management

Course number: P000498

The Programme in Engineering Management provides management training to professionals who are involved or interested in managing technical functions. Professionals involved in engineering management activities, such as development management, operations management, maintenance management, technology management and project management, who operate especially in a supervisory or managerial capacity, will benefit greatly from this programme.

Course content:
- Technology management
- People management
- Maintenance management
- Project management
- Financial management
- Systems development
- Quality management
- Operations management

Admission requirements:
Prospective delegates should have a relevant technical qualification.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Non-Destructive Testing (NDT) for Engineers

Course number: P002983
Non-Destructive Testing (NDT) is a branch of science and engineering that makes use of non-invasive techniques to determine the integrity of materials, components, structures or endeavours in order to quantitatively measure characteristics of an object without rendering it unfit for use after the intervention. This short course in Non-Destructive Testing (NDT) for Engineers is designed to make engineers aware of what NDT is, as well as how it should be managed and used as part of the engineering effort, design and operation of a plant.

Course content:
• Common NDT methods and techniques with an emphasis on their advantages and disadvantages
• Practical demonstrations of methods
• Origins of defects in castings, forgings and welding
• Codes and standards of NDT in South African industries
• Engineering NDT and the duties of the design engineer
• NDT reports and records
• Purchasing NDT and best practice according to the Health and Safety Executive (HSE) (UK)

Admission requirements:
Prospective delegates should at least have a National Senior Certificate (Grade 12) with Physical Sciences.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Forensic Toxicology

Course number: P002798
The Forensic Toxicology programme focuses on forensic chemistry and highlights the application thereof in the investigation of crime. With crime not limited to that which is committed against individuals only (homicide, theft, fraud and arson), forensic scientists are also involved in the investigation of crime against society (food adulteration, environmental pollution and the use and distribution of unsafe or illicit compounds). Forensic chemists are also typically involved in investigations that relate to drugs, fire and explosions among others.

Course content:
• Tools of analytical chemistry, statistics, chemometrics and data quality as applied to forensic toxicology
• Instrumental analytical techniques employed in forensic toxicology analyses
• Organic chemistry and forensic toxicology (includes basic physiology and pharmacology)
• Forensic toxicologist in court and expert witnessing
• Research project (literature study, practical work and report)

Admission requirements:
Prospective delegates should at least have a relevant bachelor’s degree in Chemistry.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Programme in Maintenance Management

Course number: P000499

The comprehensive Programme in Maintenance Management provides management education to professionals who are involved in maintaining the technical assets of an enterprise. The management of maintenance resources and processes are included in the programme content, as well as principles of maintenance management, condition-based maintenance, managing maintenance workers, managing finances in maintenance, managing maintenance information, maintenance improvement and strategy, and risk management.

Course content:
- Principles of maintenance management
- Condition-based maintenance
- Managing maintenance workers
- Managing finances in maintenance
- Managing maintenance information
- Maintenance improvement and strategy
- Risk management
- Maintenance approaches and strategies

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Maintenance Management

Course number: P000770

This short course in Maintenance Management provides delegates who are involved in maintenance or supervisory environments with a theoretical background and some practical exposure to problem-solving in the management of maintenance within any business enterprise. The course focuses on maintenance planning, organising and controlling, maintenance performance, reliability and maintainability management, quantitative techniques and auditing maintenance operations.

Course content:
- History and frameworks
- Maintenance planning
- Organising the maintenance resources
- Controlling maintenance performance
- Reliability and maintainability management
- Quantitative techniques
- Auditing maintenance operations
- Standard maintenance approaches

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Principles of Pyrometallurgy

Course number: P000221
The short course in the Principles of Pyrometallurgy provides delegates with practical skills in using and analysing pyrometallurgical processes, and touches on the necessary fundamentals of reaction equilibria, reaction kinetics and mass and energy balances.

CPD: ✓

Course content:
- Production Processes and Mass and Energy Balance
- Reaction Equilibria and Reaction Kinetics as Applied to the Production of Ferromanganese (MS Excel)
- Pyrometallurgical Process Analysis Techniques as Applied to the Production of Ferromanganese Modelling (FACTSAGE)

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Mechanical Metallurgy

Course number: P000372
This short course in Mechanical Metallurgy addresses the mechanical behaviour of metals at room and high temperatures. Delegates will be able to interpret the deformation behaviour of metals and alloys for the correct design and application thereof, understand and be able to apply failure analysis to any incident where failure of metals was instrumental, and optimise alloy design and heat treatment for the applicable mechanical application of alloys and metals.

Course content:
- Elastic and plastic stress strain behaviour
- Dislocations and the deformation of metals
- Engineering strengths and deformations
- Creep deformations and ruptures
- Microstructure of steels
- Property relationships of steels
- Introduction to fracture mechanics
- Fatigue failure and analysis

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

The Extractive Metallurgy of Zinc

Course number: P001624
This short course in the Extractive Metallurgy of Zinc equips delegates with the perspective and knowledge to design and operate plants for the extraction of zinc from ores. The course covers topics on the properties and uses of zinc, minerology and mineral processing, leaching in acid and alkaline media, solid liquid separation, purification and upgrading using ion exchange and solvent extraction, alternative lixiviants, refining of zinc, and the precipitation of zinc from solutions.

Course content:
- Mineral processing
- Alternative lixiviants
- Leaching
- Refractory ores
- Concentration and purification

To register online visit www.enterprises.up.ac.za
• Recovery from solution
• Refining of zinc

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Mathematical Modelling of Metallurgical Processes and Materials

Course number: P003335
The short course in Mathematical Modelling of Metallurgical Processes and Materials equips delegates with the necessary skills in applying mathematical modelling in metallurgical processes and materials to solve problems in research and industrial practice. Modelling methods, such as process balancing, thermochemical analysis and calculation, kinetic modelling, process modelling and the discrete element method, are covered to enable delegates to create models and use them in investigations.

Course content:
• Steady state process modelling
• Dynamic process modelling
• Discrete element method modelling

Admission requirements:
Prospective delegates should have a relevant bachelor’s degree in Engineering (metallurgical or chemical) and be involved in the fields of mineral processing, hydrometallurgy, pyrometallurgy, the running of a plant, design of process equipment or in research.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Engineering Geological Site Investigation Techniques

Course number: P003208
This Engineering Geological Site Investigation Techniques programme covers the general principles and approach to engineering geological site investigations and focuses on the most appropriate investigation techniques that pertain to different ground conditions and engineering structures. The course is presented on site investigation techniques for different site conditions, geological materials and engineering structures, and the acquisition of knowledge and hands-on training in index laboratory testing methods.

Course content:
• Understanding the approach to engineering geological site investigation
• Basic knowledge on site investigation techniques
• Appropriate site investigation techniques for different site conditions, geological materials and engineering structures
• Knowledge and hands-on training in index laboratory testing methods

Admission requirements
Prospective delegates should have a relevant postgraduate qualification in Engineering or Geology with at least two years’ experience in engineering geological site investigation.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Global Minerals Industry Risk Management

Course number: P002210

The Global Minerals Industry Risk Management (GMIRIM) short course introduces delegates to the primary concepts, terminology and issues surrounding risk management – particularly, as it applies to the industry. The course includes several important models of work processes, management systems and project operations that are useful in conceptualising workplace situations, and can be used to develop effective risk management strategies.

CPD: ✔

Course content:
• Safety risk management introduction
• Risk management concepts and models
• Human factors and behaviour
• Human factors and engineering
• Risk assessment and analysis background
• Risk assessment methods and application
• Scoping a risk assessment
• Introduction to safety maturity techniques
• Leading practice four-layer operational risk management
• Risk acceptability and the four layers
• Major hazard risk management
• Integrated risk management
• Safety improvement project
• Presentation of practical assignments

Admission requirements:
Prospective delegates should at least have a National Senior Certificate (Grade 12).

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Strata Control for the SHEC Mineral Resources Industry

Course number: P002975

This online course in Strata Control for the SHEC Mineral Resources Industry uses a broad and sound mine-planning process to enable an improved understanding of the specifics need for better rock engineering input in each planning phase. This course equips any manager in the mineral resources industry who has to deal with the complexities of rock engineering issues, and who constantly searches for better understanding of these issues, in a drive towards better management of their areas of responsibility.

e-Learning: 🌐

Course content:
• Mining environments
• Implementation and monitoring
• Legal environments
• Loading conditions
• Failure modes
• Planning
• Support

(Note: Assessment will consist of tests, assignments and discussions, as well as a project report and 3-hour examination at the end of the semester. The project report encompasses all understanding gained within a known or planned portion of the mine and within delegates’ areas of responsibility.)

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Programme in Blasting Engineering

Course number: P003025

The Programme in Blasting Engineering covers the basics of commercial explosives and the application thereof in surface and underground mining environments. Delegates will be trained in the basic theory of the subject and the application thereof, whilst having the chance to interact with experts in the field. This comprehensive programme is based on the undergraduate Explosives Engineering course presented in the BEng (Mining Engineering) degree at the University of Pretoria.

CPD: ✔

Course content:
• Impact of fragmentation on the mining cycle
• Specialised blasting practices
• Environment-friendly blasting
• Assessment of blasting practices
• Downstream effects of blasting results
• Safety in blasting and blasting legislation

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Mine Ventilation Engineering for the SHEC Mineral Resources Industry

Course number: P003108

Mine ventilation and refrigeration is an extremely important consideration within the modern mining environment. With rising energy costs, the depths at which mines are operating and the requirements to maintain safe working environments, there is a need to fully understand this crucial discipline of engineering. This online course in Mine Ventilation Engineering for the SHEC Mineral Resources Industry provides sound design principles with which to evaluate mines and design mine ventilation and cooling systems from the early prefeasibility stages of projects right through to the commissioning of projects.

e-Learning: 🗓

Course content:
• Terminology and definitions
• Mine planning procedures and phases
• Software and planning procedures
• Mine layout and mining methods
• Planning and active/passive ventilation control
• Diurnal and seasonal energy requirements
• Refrigeration and cooling distribution systems
• Primary and secondary ventilation systems
• Interaction and optimisation of ventilation and cooling systems
• Planning and alternative technologies/systems and recent research

Admission requirements:
Prospective delegates should at least have a relevant bachelor’s degree in Engineering or similar tertiary qualification.

Course dates and fee
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Occidental Hygiene Module for the SHEC Mineral Resources Industry

Course number: P003122
This online course in Occupational Hygiene Module for the SHEC Mineral Resources Industry introduces managers to the basic principles of occupational hygiene that will include the risk assessment process, occupational hygiene programme, monitoring of noise, thermal stress and airborne contaminants. The Mine Health and Safety Act (MHSA) and the importance of an occupational hygiene programme, and the needs to involve other disciplines, are dealt with by using specific commodity case studies. The important role of risk-based medical surveillance to manage occupational health and the advantage thereof for the mining industry is also highlighted.

e-Learning:

Course content:
- Basic principles of occupational hygiene
- MHSA and related legislation
- Occupational hygiene programme
- Monitoring strategies of occupational stressors
- Medical surveillance
- Commodity case studies

Admission requirements:
Prospective delegates should at least have a relevant bachelor’s degree in Engineering or similar tertiary qualification.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Basic Coal Preparation

Course number: P001812
The programme in Basic Coal Preparation provides operators, senior controllers and foremen on coal processing plants with a theoretical and practical introduction to coal processing. The programmes specifically focuses on topics of geology, coal preparation and the market, sampling and analysis, sizing, size reduction, coal preparation processes, solid-liquid separation, total plant control, maintenance and safety.

Course content:
- Geology
- Coal preparation and the market
- Sampling and analysis
- Sizing
- Size reduction
- Coal preparation processes
- Solid-liquid separation
- Total plant control
- Maintenance
- Safety

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Advanced Coal Preparation

**Course number:** P003309

The programme in Advanced Coal Preparation provides training in the application of theoretical and practical knowledge of coal processing for a coal processing plant. The programme provides individuals with the knowledge and skills required to solve practical problems that are experienced during day-to-day running of a coal processing plant. Delegates are acquainted with basic science, sampling, coal science, coal processing, sizing and size control, general coal concentration processes, dense medium separation and dewatering.

**Course content:**
- Basic science
- Sampling
- Coal science
- Coal processing
- Sizing and size control
- General coal concentration processes
- Dense medium separation
- Dewatering

**Admission requirements:**
Prospective delegates should have a minimum of five years’ basic coal processing or coal preparation plant experience.

**Course dates and fee:**
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Railway Engineering

**Introductory Multi-Disciplinary Concepts in Railway Engineering**

**Course number:** P000602

The short course in Introductory Multi-Disciplinary Concepts in Railway Engineering introduces basic principles of each railway engineering field, together with a general background on how railway transport systems operate. The course also covers the complexities of the multidisciplinary interrelationships that are found in the railway system.

**Course content:**
- Principles applicable to each railway engineering field
- Railway transport system operation
- Multidisciplinary interrelationships in railway systems

**Admission requirements:**
Prospective delegates should at least have a relevant diploma or bachelor’s degree in Engineering and/or relevant working experience.

**Course dates and fee:**
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Wheel Rail Interaction (WRI)

Course number: P000603
The short course in Wheel Rail Interaction (WRI) provides railway, heavy-haul and wheel-infrastructure maintainers with an introduction to the guidelines for best practices of heavy-haul railway operations as related to rail and wheel interface issues.

CPD:

Course content:
- Macro-interaction mechanics (vehicle and track)
- Micro-interaction mechanics (wheel and rail)
- Contact mechanics and tribology
- Standards and interventions
- Measuring technologies and condition assessments
- Track and vehicle maintenance strategies
- Rail grinding and lubrication
- Case studies

Admission requirements:
Prospective delegates should have relevant working experience in railway, heavy-haul, and wheel-infrastructure maintenance.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Railway Infrastructure Maintenance Management

Course number: P000623
The short course in Railway Infrastructure Maintenance Management introduces delegates in the railway industry to the general principles of railway asset management and its relationship (as part of a system) with the business plan. The course deals with the appropriateness of the design of particular railway systems to prevailing and future business needs, as well as the development of life-cycle maintenance plans and the ability to adapt these to changing business circumstances.

CPD:

Course content:
- Key facets of the management of a railway asset and its life-cycle
- Railway asset management as part of a system
- Relationship with the business plan

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Track Geotechnology

Course number: P001351
The short course in Track Geotechnology presents a short review of geology, track loading and the fundamentals of soil mechanics, followed by the more practical areas of earthworks, subgrade, ballast and drainage. After completion of the course, delegates will be able to apply a sound and practical working knowledge of the soil fundamentals that are relevant to the multi-layered track substructure to the construction and maintenance of a railway track.

CPD: ✓

Course content:
• Soil fundamentals
• Multi-layered systems and design
• Earthworks construction and specification
• Drainage
• Track substructure investigation measures and maintenance management
• Case studies

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning; Alternatively, delegates should have a diploma in the relevant field of study.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Locomotive Systems, Performance and Maintenance

Course number: P001572
The short course in Locomotive Systems, Performance and Maintenance introduces delegates to the basic principles and functioning of locomotive systems together with guidelines on performance measurement and the maintenance philosophy as applied to locomotive systems, locomotive interaction with infrastructure, the function and workings of locomotive subsystems and maintenance best practices.

CPD: ✓

Course content:
• Railway transport in context
• Railway operating concepts
• Maintenance concepts and philosophies
• Locomotive interaction with infrastructure
• Locomotive subsystems: function and working
• Maintenance best practices
• Locomotive performance parameters
• Locomotive operation requirements

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Management of Continuously Welded Rails

Course number: P001822
The short course in the Management of Continuously Welded Rails provides an in-depth understanding of the basic principles and management of continuously welded rails (CWR) theory and the practical application thereof. Other focuses include rail forces and track loading, rail manufacturing and basic properties, rail welding and failures; vertical and horizontal stability, rail breaks, kick-outs and destressing; stress-free temperature methods, and more.

CPD: ✓

Course content:
• Rail forces and track loading
• Rail manufacturing and basic properties
• Rail welding and failures
• CWR theory and principles
• CWR applications
• Vertical and horizontal stability
• Rail breaks and kick-outs
• Stress-free temperature methods
• Rail destressing
• CWR management
• TFR experience
• Advanced CWR applications
• Various case studies

Admission requirements:
Prospective delegates should have relevant working experience and/or a diploma in the relevant field of study.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Introduction to Railway Projects and Processes

Course number: P001984
Introducing young engineers to the multi-disciplinary field of railway engineering (with an emphasis on railway projects and processes), this introductory short course in Railway Projects and Processes employs infrastructure construction and scheduled maintenance blocks to acquaint delegates with the principles of planning and management. Other areas of focus include logistics and supply, time, cost and quality management, communication management, and railway safety and risk management.

CPD: ✓

Course content:
• Infrastructure projects
• Maintenance projects
• Logistics and supply
• Time, cost and quality management
• Communication management
• Railway safety and risk management
• Resource planning
• Integration of railway projects

Admission requirements:
Prospective delegates should have relevant working experience and/or a relevant diploma or bachelor’s degree in Engineering.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Railway Asset Management

**Course number:** P002396

Asset managers and railway workers involved in maintenance and engineering will greatly benefit from this short course in Railway Asset Management. Delegates are introduced to the general principles of railway asset management with a focus on developing an understanding of the appropriateness of the design of the railway system, the prevailing and future business needs (together with the development of life-cycle maintenance plans), and the ability to adapt it to changing business circumstances.

**Course content:**
- Key facets of the management of a railway asset
- Life-cycles and the relationship between railway asset management
- Systems and the business plan

**Admission requirements:**
Prospective delegates should have relevant working experience and/or prior learning.

**Course dates and fee:**
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Railway Safety Investigation

**Course number:** P002755

The short course in Railway Safety Investigation provides employees in the railway industry with a consistent approach to initiating, conducting and reporting on an investigation into railway occurrences, with a view to identify safety deficiencies and propose remedial action in order to prevent similar future occurrences. Among other focuses, delegates will be acquainted with a systematic approach to the investigation of train safety incidents and vehicle, infrastructure and operational aspects needed for safe and orderly operation of a railway.

**CPD:**

**Course content**
- Site investigation and cause finding procedure
- Data collection, evidence reconstruction and presentation
- Main line derailments
- Derailments at turnouts
- Slow-speed derailments
- Hump yard derailments
- Wagon issues and train derailments
- Locomotive issues and train derailments
- Track issues and train derailments
- Failure analysis
- Train handling and marshalling issues in train derailments
- Track-wagon dynamics
- Computer simulations in train derailment investigations

**Admission requirements:**
Prospective delegates should have a BEng or a BTech degree.

**Course dates and fee:**
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
**Signal Processing and Wiring**

**Practical Wiring**

**Course number:** P000384

This short course in Practical Wiring provides delegates with an introduction to wiring principles and focuses on designing electrical projects, wire installation, test installation, wire electrical control equipment and testing motors. After completion of the course, delegates will be able to pass the skills test for wiring principles.

**Course content**

- Designing electrical projects
- Wire installation
- Test installation
- Wire electrical control equipment
- Testing motors

**Admission requirements:**
Prospective delegates should have relevant working experience and/or prior learning.

**Course dates and fee:**
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

---

**Practical Wiring and Signal Processing for Electrical Engineers**

**Course number:** P001284

Revolutionary changes in digital signal processing (DSP) technology have already been made in a broad range of fields including communications, medical imaging, radar and sonar, high fidelity music reproduction and oil prospecting. DSP education involves learning general concepts that apply to the field as a whole, and learning specialised techniques for your particular area of interest. This course in Practical Wiring and Signal Processing for Electrical Engineers equips undergraduate Electrical Engineering students with the basics of DSP for practical application.

**Course content:**

- Breadths and depths of DSP
- Statistics, probability and noise
- ADC and DAC
- DSP software
- Digital filters
- Theoretical design of anti-aliasing filters
- Practical design and testing of anti-aliasing filters
- Design of protection circuits
- Design of offset circuits for unipolar ADCs
- Practical introduction to the DSP
- Experiments with flashing LED, ADC, RMS and serial communication

**Admission requirements:**
Prospective delegates should be students who have successfully completed their third year of study in Electrical Engineering.

**Course dates and fee:**
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Spreadsheets

Spreadsheets as an Engineering Tool

Course number: P000036

The short course in Spreadsheets as an Engineering Tool demonstrates the use of Microsoft Excel as a powerful processing tool. After completion of the course, delegates will have knowledge of the uses of Microsoft Excel, including built-in functions, user-defined functions, customisations, graphs, macros and VBA. The course also focuses on the function wizard, development and implementation of user-defined functions, graphs and charting capabilities in Excel, the Data Analysis Toolpack and using the forms facilities and macros.

CPD: ✓

Course content

- Accessing and using the function wizard
- Developing and implementing user-defined functions
- Graphs and charting capabilities in Excel
- Data Analysis Toolpack and statistical analysis facilities
- Solver (answering questions, Solver add-in, scenario manager and data tables)
- Matrix calculations
- Advanced topics: customising Excel, forms facilities and developing basic macros

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Systems Engineering

Systems Engineering Management

Course number: P003313

A project manager remains responsible and accountable for the success of a project whereas a systems engineer remains responsible for the systems engineering and other engineering activities of the project. The short course in Systems Engineering Management focuses on systems engineering management where delegates are exposed to relevant management principles, processes and standards, and the development of the Systems Engineering Management Plan (generally known as the SEMP).

CPD: ✓

Course content:

- Overview of the system life cycle
- Introducing management
- Introducing project management models (PMBOK, PRINCE2, Agile project management such as SCRUM)
- Systems engineering management models
- Difference between project management and systems engineering management
- Management responsibilities
- Organising systems engineering management
- Management metrics
- Systems engineering management planning, formal plans
- Technical design reviews and audits
- Managing change
- Leadership styles
- Leadership versus management
- Organising for success
- Role of organisational culture
- Motivating your team
- Decision-making
- Importance of communication
- Taking ownership of a project
- Managing stress and dealing with conflict
- Behaviour patterns and their role
- Importance of team building
- Assessing team performance
Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Requirements Engineering

Course number: P003314
Almost all system failures can be traced to a problem with the system’s requirements. Such failures are usually attributed to poor requirements engineering practices and requirements management, as well as poor understanding of the actual need or problem that must be solved by the system. This course in Requirements Engineering provides delegates with the necessary insight, understanding and skill to effectively elicit a client’s needs and convert this into feasible and realistic systems.

CPD: ✓

Course content:
• Writing effective specifications
• Impact of poor specifications on tenders and contracts
• Introduction to specification types
• Structuring a specification
• Appropriate language and style
• Good specification processes
• Allocating responsibilities
• Identifying stakeholders (stakeholder analysis)
• Analysing clients’ needs and elicitation techniques
• Requirements analysis process
• Requirement types
• Transforming clients’ need to an engineering requirement
• Overview of different requirements engineering tools
• Analysing risks
• Managing specifications
• Specification tree
• Specification planning and plans
• Reviewing a specification
• Configuration and change control
• Maintaining traceability
• Case studies and practice sessions

Admission requirements:
Prospective delegates should have relevant work experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
**Systems Design**

**Course number:** P003315

Although most engineers and technical specialists are taught how to design products and solutions, most are not taught the importance of higher-system level design and the functional integration that is a prerequisite for a successful outcome. The course in Systems Design focuses on three important aspects that need to be achieved to ensure a successful product: systems engineering fundamentals, systems architectures and systems design.

**CPD:** ✓

**Course content:**
- Role of systems engineering in successful projects
- History of systems engineering
- Introducing the system life-cycle model
- Systems engineering processes
- Overview of popular models
- Moving from requirements to solution to product
- Integration of speciality engineering
- Introducing model-based systems engineering
- Advanced systems engineering concepts
- Systems engineering standards
- Fundamentals of system architecting
- Architecture frameworks (Zachmann, TOGAF, DODAF, MODAF)
- Developing a system architecture
- Overview of system architecting tools
- Test and evaluation of systems
- Proceeding from system design to test and evaluation
- Test planning
- Test design
- Role of modelling and simulation
- Dealing with test and evaluation of software; why is it different?
- Case study and practical exercises

**Admission requirements**

Prospective delegates should have relevant working experience and/or prior learning.

**Course dates and fee:**

For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

---

**Programme in Systems Engineering**

**Course number:** P003317

Engineers and managers in industry are expected to deal effectively with ever-increasing plant, product and system complexities. Many of the projects dealing with such systems are expensive, carry high risks and suffer from a shortage of skilled human resources. The Programme in Systems Engineering is aimed at working with these professionals. With its modular configuration, this course is now more flexible than before.

**Course content:**
- Systems engineering management
- Building high performance teams
- Writing effective specifications
- Requirements engineering
- Managing specifications
- Systems engineering fundamentals
- Systems architecture and design
- Test and evaluation of systems

**Admission requirements:**

Prospective delegates should have relevant working experience and/or prior learning.

**Course dates and fee:**

For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
Water

Pipeline Design, Operation and Maintenance

Course number: P002719
The short course in Pipeline Design, Operation and Maintenance focuses on the practical aspects of pipeline design, the theory of pipeline engineering and the optimisation process. The effect of energy escalation in pump systems is also reviewed and delegates will become confident with the design of pipeline systems. Other aspects include: pipeline hydraulics, surge analysis, pipeline component design, pipeline installation, life-cycle costing, testing and the operation of pipelines.

Course content:
• Theoretical knowledge with regard to pipeline engineering
• Optimisation and life-cycle costing analysis
• Pipeline hydraulics
• Dynamic analyses
• Pipeline component design
• Conduit hydropower design and installation
• Pipeline installation, testing and operation

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.

Centrifugal Pump Sizing

Course number: P003341
The short course in Centrifugal Pump Sizing covers the basic principles that are needed in the sizing of centrifugal pumps. The course focuses on centrifugal and positive displacement pumps, piping hydraulics for sizing pumps, pump sizing, Net Positive Suction Head (NPSH) and prevention cavitation, pump affinity laws, series and parallel pumps, water hammer, pump sparing, pumps for slurry handling, pump checklists and workshop problems. The skills and techniques are relevant to all sectors of business and government.

Course content:
• Centrifugal and positive displacement pumps,
• Piping hydraulics for sizing pumps
• Pump sizing
• NPSH and prevention Cavitation
• Pump affinity laws
• Series and parallel pumps
• Water hammer
• Pump sparing
• Pumps for slurry handling
• Pump checklist
• Workshop problems

Admission requirements:
Prospective delegates should have relevant working experience and/or prior learning.

Course dates and fee:
For group bookings, send an email to info@enterprises.up.ac.za. Scheduled dates and prices are available on www.enterprises.up.ac.za.
To register online visit www.enterprises.up.ac.za

For quotations on in-house training, email quote@enterprises.up.ac.za

+27 (0)12 434 2500  +27 (0)12 434 2505  info@enterprises.up.ac.za  Private Bag X41, Hatfield, 0028

www.enterprises.up.ac.za

Shifting knowledge to insight