Project ID:	**19P01**
Supervisor:	Prof Ken Nixon
Title:	Downloading geoscience field instrument measurements over Wi-Fi
Overview:	The heart of this investigation involves finding a solution to making geoscience instrumentation measurements from legacy physical and data formats available over Wi-Fi. Geoscientists use a variety of expensive instruments during field work, which commonly outlast the computer download interface and software, leading to their unnecessary retirement. A significant challenge is that many of these instruments have different output interfaces - examples include serial 25-pin or 9-pin RS232, parallel DB-25 and USB (a/b/c). Additionally the protocol and data format may not be well documented. Starting with a single instrument such as a magnetometer, students will need to develop a solution that makes the measurements recorded available over Wi-Fi. The exact shape-and-form of the Wi-Fi system will need to be elicited from the end-user. The basic system will need to be extended by giving consideration to different instruments, different interfaces and possibly developing an heuristic algorithm to automatically determine what data is being sent out from the instrument. Given that the system may be used out in the field it will be important that the solution is energy efficient. This project will require students that are passionate about finding solutions using hardware and software systems - fair warning: there is no solution to this problem available online.
Field(s) of Study:	Information and Software
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P02**
Supervisor:	Prof Ken Nixon
Title:	Applying analytics to an induction furnace
Overview:	The engineer responsible for a production facility that makes use of a large (6 MW) induction furnace has requested an investigation into making use of voltage, current and temperature measurements being made on the furnace for accurate condition monitoring and preventative maintenance purposes. Note that these measurements will be provided for the study - students taking the project will not need to make them.
Field(s) of Study:	Information and Software
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P03**
Supervisor:	Dr Hugh Hunt
Title:	Remote access lightning current measurement system
Overview:	One of the key parameters of lightning events is the current impulse associated with the event (peak current, rise time, fall time, harmonic content etc.). Direct measurements of these current s provide invaluable information for use in national and international standards as well as too the lightning protection industry in general. However, the stochastic nature of lightning means that making direct measurements is challenging - it requires a costly measurement system, installed at a location that may possibly only be struck once a year if that (https://www.youtube.com/watch?v=_8cDysr7iPM). The need for a remote access, cost effective measurement system which could be deployed at multiple locations is evident. This project involves developing such a system (some investigations such as this - https://ieeexplore.ieee.org/document/8503475, can be used to inform the design) and testing the system in the HV laboratory to confirm its accuracy.
Field(s) of Study:	High Voltage
Prerequisites:	HV course
Suitable for EE, IE or both:	EE

Project ID:	**19P04**
Supervisor:	Dr Hugh Hunt
Title:	Ground-Strike Point (GSP) analysis over Johannesburg, South Africa
Overview:	Ground-flash density maps have long been used to quantify the amount (and therefore risk) of lightning in an area. With the introduction of modern lightning location systems, the accuracy of these maps has greatly improved. However, recently there has been discussion around lightning events with multiple ground-strike points - lightning that strikes two or more locations at the same time. Distinguishing these events with a lightning location system is not immediate, and different algorithms exist to process the data into this format. This project involves implementing one of these algorithms and using this to investigate the ground-strike point density over Johannesburg, South Africa.
Field(s) of Study:	High Voltage
Prerequisites:	HV course
Suitable for EE, IE or both:	both

Project ID:	**19P05**
Supervisor:	Prof Ling Cheng
Title:	Mirror, mirror on the wall
Overview:	According to the recent paper "Computational periscopy with an ordinary digital camera" [Nature 565, 472475 (2019)], "computing the amounts of light arriving from different directions enables a diffusely reflecting surface to play the part of a mirror in a periscope". In this project, the candidates are required to collect the data of reflected lights via a specified surface categorised as a normal office wall surface with a camera without lens, and to classify a set of candidate objects which generates the reflected lights at a reasonable accuracy.
Field(s) of Study:	Telecommunications
Prerequisites:	n/a
Suitable for EE, IE or both:	both

Project ID:	**19P06**
Supervisor:	Prof Michiel Postema
Title:	Sonic suction
Overview:	Any vibrating entity creates a net force in the axial vibration direction. In sound fields, this phenomenon is called acoustic streaming. Suction, i.e., particle movement towards the vibration source, is far more complicated to achieve. But contrary to popular belief, this is not impossible. This project analysis the nonlinear waveforms required for sonic suction. The prime deliverable of this project is a speaker that literally sucks. Other deliverables consist of theoretical models under which sonic suction occurs.
Field(s) of Study:	Biomedical
Prerequisites:	EE, experimental skills, programming
Suitable for EE, IE or both:	EE

Project ID:	**19P07**
Supervisor:	Prof Michiel Postema
Title:	Shear-wave generator
Overview:	Ultrasonic shear wave imaging is a novel medical visualisation technique, surpassing conventional ultrasonic imaging with axial longitudinal waves in resolution and biological interpretation possibilities. Instead of purchasing state-of-the-art seriously expensive new machinery, for straightforward and simple lab experiments with shear waves it is desirable to upgrade existing acoustic longitudinal-wave generating equipment to produce shear waves. This project has as a purpose to convert single-element transducers to shear-wave generators, by adding plate components. A full analysis of geometric configurations is part of the project. The final deliverable is a working shear-wave generating transducer.
Field(s) of Study:	Biomedical
Prerequisites:	EE, experimental skills, programming.
Suitable for EE, IE or both:	EE

Project ID:	**19P08**
Supervisor:	Prof Vered Aharonson
Title:	Detection of depression from speech
Overview:	Depression is a prevalent mental disorder (The World Health Organization estimated that 350 million people of all ages worldwide suffer from depression), and is a disabling condition that impairs an individuals ability to cope with daily life. Accurate diagnosis of Depression requires intensive training and experience, it is time consuming and need professionals to diagnose. Tone and manner of speech of depression patients have been shown as significant element in psychologists diagnosis. This projects goal is to develop a home depression detection tool, based on speech and implemented in a smartphone. The detection algorithm will be developed using the DAIC (The Distress Analysis Interview Corpus) dataset (available online) - which consists of interviews with participants at risk for Major Depression. The application will prompt the user to answer questions , record the speech analyze and return depression score to the user and/or doctor.
Field(s) of Study:	Biomedical
Prerequisites:	Good skills of signal processing. Preferable: speech processing. GUI/game design.
Suitable for EE, IE or both:	both

Project ID:	**19P09**
Supervisor:	Mr Abdul-Khaaliq Mohamed
Title:	Robust adaptive EMG interpretation for control of a robotic prosthetic hand
Overview:	People who have experienced hand amputations can regain key hand functionality via a prosthetic hand controlled by the human nervous system using electromyogram (EMG) from the remaining functional muscles in the upper arm. One such way is to use contractions of the bicep and tricep muscles to initiate different types of hand movements on the robotic prosthetic hand. This project forms part of a larger research aim, which is directed towards the design and construction of a neurally-controlled prosthetic hand with multiple degrees of freedom that will function similar to a human hand. The amalgamation of the following lab projects has led to the development of two prototype robotic prosthetic hands, which aim to eventually realise this larger aim: 1. Prototype Robotic Prosthetic hand - 2014 2. "EMG control of a simulated Prosthetic hand - 2015 3. "Enabling grip control of a prototype robotic prosthetic hand - 2015 4. "Fine Grip Control of a robotic EMG-based prosthetic fingers - 2016 5. Grip control of robotic prosthetic hand using haptic feedback - 2017 6. Grip and Gesture Control of Robotic Prosthetic Hand 2018 7. Development of Low Cost Multi-Channel EMG Recording System and Mobile Power Supply System for a Prosthetic Hand - 2018 Further developments and improvements are still needed, especially in the area of real-time EMG data analysis and movement intention detection. Hence, the aim of this project is to advance the EMG analysis algorithm of the existing prototype. Project Objectives 1. Understand and test the existing EMG analysis algorithm on the prototype robotic prosthetic hand. 2. Using the 8-channel EMG machine provided, design and implement a new algorithm to analyse and detect bicep and tricep contractions that would respectively cue the prosthetic hand to perform a full finger flexion and a tripod pinch. The algorithm needs to detect the users intention to perform these two movements in spite of muscle fatigue, natural changes to the EMG signals and natural movements of the arm. The algorithm must be implemented in Matlab and work in real-time. 3. Design an efficient way to calibrate the algorithm for different users. Bonus objectives of the project involve: 1. Implement and test the algorithm on the prototype prosthetic hand
Field(s) of Study:	Biomedical
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P10**
Supervisor:	Prof Vered Aharonson
Title:	Monitoring mood changes from daily routine patterns
Overview:	Depression is a prevalent mental disorder (The World Health Organization estimated that 350 million people of all ages worldwide suffer from depression), and is a disabling condition that impairs an individuals ability to cope with daily life. Accurate diagnosis of Depression requires intensive training and experience, it is time consuming and need professionals to diagnose. Changes in daily routine (i.e. sleeping hours, amount of social interactions, getting out of the house) are often a first indicator to mood changes and have been shown as good monitoring tool for depression patients. This projects goal is to develop a daily routine monitoring tool, based on smartphone sensors. The application will employ data collected by todays smartphone (i.e. screen time, activity, number of calls/messages, location), and analyse the patterns.
Field(s) of Study:	Biomedical
Prerequisites:	Good skills of signal processing. Mobile platform computing.
Suitable for EE, IE or both:	both

Project ID:	**19P12**
Supervisor:	Mr Mitch Cox
Title:	Software Defined Laser communications
Overview:	Communication in the modern era was revolutionised by the invention of the telephone in 1876. The use of the copper and microwave radio infrastructure built for telephones eventually led to the Internet, which is now ubiquitous. In the 1970s, fibre optic communications technology began to replace the existing copper backhaul infrastructure due to the fact that it is cheaper, higher bandwidth and longer range. Unfortunately, there are many places on Earth that are still not connected by fibre, resulting in the digital divide. Free-space, laser-based optical communication is a viable alternative to fibre optics. In this project, students are required to implement a radio over optical setup in the Optical Communication Lab, which is well equipped for the project. The level of success of the project will be based on the achieved bandwidth of the link and the elegance of the solution, which must be engineered carefully. Due to the coupled hardware and software nature of the project, interested groups should be skilled in electronics as well as telecommunications. This project may form the basis for an MSc in optical communications for interested candidates.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P13**
Supervisor:	Mr Mitch Cox
Title:	What do machines see when they look at lasers?
Overview:	The Internet is endangered... We are rapidly approaching the Shannon Limit in optical fibres due to power limits and non-linear effects. This is known as the capacity crunch, and has spurred the development of alternative optical communication technologies. Mode Division Multiplexing uses optical modes such as Orbital Angular Momentum modes to multiplex multiple data streams into a single optical channel such as a fibre or free-space link. The separation of these modes remains a challenge, especially in the presence of atmospheric turbulence, for instance. Conventionally, holographic techniques are used to perform a modal decomposition of an incoming laser beam. This requires expensive equipment and experimental prowess. Fortunately, in a lab environment, it is possible to perform this decomposition using a simple experimental setup, a camera, and digital processing. In this project, students are required to implement the experimental setup and processing required to perform a digital modal decomposition. Due to the noisy, image-based nature of the measurements, machine learning is potentially a good alternative to the existing signal processing techniques. The question is how much better or worse? Interested groups should be skilled both practically as well as in software development. This project may form the basis for an MSc for interested candidates.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P14**
Proposed by Students:	19G04 : Jason Parry, Muhammed Cassim
Supervisor:	Prof David Rubin
Title:	A cost-effective, portable sign language to speech translator
Overview:	This project involves the version of sign language known as finger spelling and is aimed at improving the methods of communication available to people who have hearing impairments. The final goal of the project is to allow the user to finger spell words and have their gestures translated into speech in order to communicate with people who may not know sign language. Additionally, the solution should be cost-effective - to facilitate access by hearing impaired people in a low-income group - and portable - to allow users of the device to access its functionality wherever they travel. The project may be broken down into three main components. The first component involves a hardware aspect - a glove is to be built which, using relevant sensors, can detect the state of each finger (the extent to which it is flexed) and translate this into a measurement which may then be used in the next component. The second component of the project involves both hardware and software aspects - the gesture for each letter in the sign language alphabet is performed multiple times with the glove on and the measurements are recorded. These measurements are used as a training set in a machine learning algorithm (most likely a neural network) to classify each gesture correctly. The third and final component requires the classified gestures to be concatenated to form words. These words are then played as speech to achieve the full project functionality. Further extensions on this project are possible, time permitting. This entails the development and implementation of a machine learning algorithm which dynamically re-trains itself as the user gestures. This personalises the glove to the specific user and improves gesture classification. Additionally, signs for whole words could be added to the library of known gestures to increase the speed of signing. The project success will be assessed by its ability to translate an English, sign language sentence containing every letter in the English alphabet to speech (a pangram such as "The quick brown fox jumps over the lazy dog") . It will additionally be evaluated under the categories of cost and portability so that the project completes its initial goals.
Field(s) of Study:	Biomedical
Prerequisites:	None specified
Suitable for EE, IE or both:	

Project ID:	**19P15**
Supervisor:	Ms Ellen De Mello Koch
Title:	Heartbeat sound segmentation and classification
Overview:	According to the World Health Organisation, cardiovascular diseases (CVDs) are the number one cause of death globally. Methods which aid in the detection of signs of heart disease could therefore have a significant impact on world health. Students are required to implement a method that can locate sounds particular to a heart (aka lub & dub, which are technically called S1 and S2) within audio data and then segment the audio files on the basis of these sounds. After segmenting the sounds, a method to classify a heartbeat into normal and diseased categories must be implemented. The dataset for this project can be found at: https://www.kaggle.com/kinguistics/heartbeat-sounds/kernels
Field(s) of Study:	Biomedical
Prerequisites:	Software and signal processing
Suitable for EE, IE or both:	both

Project ID:	**19P16**
Proposed by Students:	19G05 : Tyson Cross, Jason Smit
Supervisor:	Dr Hugh Hunt
Title:	Image segmentation of lightning events using machine learning
Overview:	We propose the development of an image segmentation system to identify areas of the screen as lighting, sky, horizon or occluding features (buildings, etc.) using a machine learning approach. The input to the system will be high-speed footage of lightning strikes from a fixed camera, with sets of pixels (super-pixels) classified as limited features at the output. Previous work in this area has required substantial manual pre-processing of video footage to be usable for successful classification. We propose extending the work in A Computer Vision System To Analyse Images Of Lightning Flashes by Gin, Bianchi and Pilon (University of FEI, Brazil) to use machine learning techniques to detect and classify regions which represent semantic features useful in further analysis, without manual region input. Ideally, the system will be a single neural network which performs pixel partitioning and mask creation along with feature classification. After the success criteria is met, with robust and confident identification of regions of frames with and without lighting, the project could lead to a more sophisticated analysis of the frame-by-frame development of a lightning strike, with deeper classification of the direction of the flashes (VF/HF). If this is achieved, the system could be extended to detection and classification of individual components of regions of lightning (multiple stokes, leaders, etc), speed of stokes.
Field(s) of Study:	High Voltage
Prerequisites:	None specified
Suitable for EE, IE or both:	

Project ID:	**19P17**
Supervisor:	Prof. Chandima Gomes
Title:	Development of a prototype personal lightning safety structure
Overview:	In mining, fisheries and entertainment industry, Golf courses, early stage construction sites etc. it is highly essential to have some sort of personal or group lightning safety structure (LSS) that can easily be implemented and possibly be portable. So far no such attempts are made which could be carried towards commercial success. In this project the couple of students are given a basic conceptual structure for a personal LSS, which should be analysed and optimized with the aid of a suitable software; for optimum dimensions, material thickness, material types, joint impedance etc. to avoid side flashing and step / touch potentials. The finally designed structure should be implemented with suitable materials and tested by applying the 8/20 s and 10/350 s current impulses from the generators available at the HV laboratory. One student may focus more towards the simulation side whereas the other may focus more on experimental part.
Field(s) of Study:	High Voltage
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P18**
Supervisor:	Prof. Chandima Gomes
Title:	Determination of step potential hazard in a human body with foot insulation
Overview:	One of the long-debated controversies in the lightning safety science is the protection given by insulated footwear to a human body in the event of lightning generated ground currents. It is well known that the step potential in the vicinity of lightning current injection point depends on soil impedance. However, no firm studies have been done on finding the partial currents that enters a human body under various conditions when the person is subjected to step potential. In this study we physically develop a human body model with suitable electrical components and two metal plates to represent human feet. Placing the system on a sand filled container we apply 1.2/50 s voltage impulse from the Marx generator available at the HV lab and measure potential at the two feet and the current through the body model. The experiment will be repeated with several types of insulation materials, each with several layer thickness. The resistivity and permittivity of soil and insulation materials are measured (or data is obtained from reliable sources). The setup is simulated in by the aid of a suitable software and validated with obtained experimental results. Then the simulation could be extended to real life situations. One student may focus more towards the simulation side whereas the other may focus more on experimental part.
Field(s) of Study:	High Voltage
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P19**
Supervisor:	Dr Stephen Levitt
Title:	Analysing the use of C++ features in Software Development II projects
Overview:	A number of different C++ concepts are taught during Software Development II. This project will involve writing code to analyse the code bases submitted for the course project in order to establish which C++ features (static, smart pointers, STL algorithms, etc) are being utilised by students, and to what extent. These findings will need to be related to the course content, the timing of the presentation of the content, and material available on the internet in order to understand how these factors influence project submissions.
Field(s) of Study:	Information and Software
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P20**
Supervisor:	Prof Alan Clark
Title:	RFI measurement for EMC automation of the anechoic chamber
Overview:	As a follow on from the Automation of the Anechoic Chamber project, we now have the Nuts-and-Bolts of the basic system. What now needs to happen is an emphasis on the calibration aspects, and an extension of the automation software to become a Setup, pointy clickey, walk away for coffee, print the results. A Precompliance facility is what is desired, such that electrical equipment can be accurately measured (especially) for Electromagnetic emissions. Work has been done on the Hardware and Software automation of this, but now needs the "Next Level", where the basic stuff can be turned into something really useful. Two aspects: Lots of software to control the process, and lots of hardware (PCB's etc) to develop the Noise sources for calibration purposes. We need to know what we are measuring! Standard Gain Horns will need to be manufactured.
Field(s) of Study:	Computational Electromagnetics
Prerequisites:	HF for 1 member
Suitable for EE, IE or both:	both

Project ID:	**19P21**
Supervisor:	Prof Alan Clark
Title:	NEC engine
Overview:	Timothy Rokebrand's M.Sc. has moved us forward in implementing an Open Source antenna simulation framework which is independent of the underlying engine geometry. A lot more work is required on specific antenna types to validate (build-and-test) the simulation environment of the antenna family of your choice. ie computational and hardware project!
Field(s) of Study:	Computational Electromagnetics
Prerequisites:	HF for 1 member
Suitable for EE, IE or both:	both

Project ID:	**19P23**
Supervisor:	Ms Ellen De Mello Koch
Title:	Respiratory disease classification
Overview:	Respiratory health indicators and disorders can be detected in audio recordings of respiration. Factors such as air movement, changes within lung tissue and the position of secretions within the lung are directly related to respiratory sounds. A wheezing sound, for example, is a common sign that a patient has an obstructive airway disease like asthma or chronic obstructive pulmonary disease (COPD). Various recording techniques exist to capture these sounds such as digital stethoscopes. Digital data from these recordings open up new avenues of using machine learning to automatically diagnose respiratory disorders like asthma, pneumonia and bronchiolitis, to name a few. Students are required to implement a machine learning algorithm that correctly classifies respiratory diseases from audio data. Dataset can be found at https://www.kaggle.com/vbookshelf/respiratory-sound-database
Field(s) of Study:	Biomedical
Prerequisites:	Software and signal processing
Suitable for EE, IE or both:	both

Project ID:	**19P24**
Supervisor:	Dr Stephen Levitt
Title:	An investigation into complex classes in OO systems
Overview:	An object-oriented software application usually consists of multiple classes. Classes which are relatively complex represent a high risk for introducing bugs. The goal of this project is to identify and investigate these high risk classes. This will be done by creating an analysis tool which is able to take in code repository and generate visualisations which relate to class complexity, including the relationship of class complexity to file or class churn, test coverage versus complexity, and, possibly, the number of issues logged versus complexity. A number of open-source GitHub projects will then need to be analysed using the tool.
Field(s) of Study:	Information and Software
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P25**
Proposed by Students:	19G03 : Katlego Gagoopane, Sello Fotoyi
Supervisor:	Dr Otis Nyandoro
Title:	Design and development of an algorithm for a sliding gate controller
Overview:	With increasing ownership of vehicles and the security concerns that accompany this growth, the demand for low-cost, easy-to-use automatic gate operators is increasing. Majority of existing gate operators (HANSA, ET, GEMINI and DTS) continue to use archaic technologies and have not taken advantage of recent developments in automation and control. The aim of the proposed project is to explore the use of modern control algorithms for dc motors through the design and implementation of a controller for an existing domestic sliding gate operator. Modelling the gate to be driven as the plant of interest, the function of the controller will be to monitor and control its position and speed under varying operating conditions using a battery operated DC motor. In addition to providing an improved interface for programming and diagnosis, the controller must be able to; Interface with a Centurion D2-turbo gearbox and Digital Origin Seeking System, perform standard controller and management algorithms such as allowing the user to program limits of travel, respond to commands issued from any valid access control device to drive the gate to its desired position and sense for collisions with objects in the gate's path preventing it from crashing into those objects.
Field(s) of Study:	Systems and Control
Prerequisites:	None specified
Suitable for EE, IE or both:	

Project ID:	**19P26**
Supervisor:	Dr Gbolahan Aiyetoro
Title:	Handover management in next generation wireless networks using cross layer design approach
Overview:	The exponential increase in number of mobile devices, recent evolution of heavy traffic mobile services and the need for improvement of spectral efficiency has led to the deployment of smaller cells in next generation wireless networks. Such an ultra-dense network containing higher number of small cells will necessitate the need for more handover processes to take place. Hence, the need for an effective and less complex handover management scheme in present and future mobile networks. In this project, the students are expected to investigate the handover management problem and propose a handover algorithm using cross-layer approach that will improve the performance of next generation networks.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	IE

Project ID:	**19P27**
Supervisor:	Dr Gbolahan Aiyetoro
Title:	Design and construction of an electronic smart nose
Overview:	The continuous emissions of pollutants into the air has led to negative effects on the climate and other health hazards. This has necessitated the need for effective monitoring, prediction and control of air quality. Hence, the need for an air quality solution that can be achieved using an effective and robust electronic smart nose. In this project, the students will design and construct an electronic smart nose using gas sensors. The nose is able to measure the quantity of certain air pollutants (gases) in the air and depending on the needs of the user, its able to either send warning message or control the sources of air pollutants. The students are expected to keep a log of the measurements and possibly use this to predict the pollution pattern in a particular environment.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P28**
Supervisor:	Mr Craig Carlson
Title:	Are they breathing?
Overview:	An issue that is frequently encountered in the overburdened public medical system is the time taken to triage patients, and obtain accurate and reliable vitals. One such reading is the measurement of the patient's respiratory rate (and associated characteristics). The aim of this project is to design and build a non-invasive system that can quickly and accurately display the respiratory rate of patients, with the intention to be used in an emergency triage setting. Bare in mind that not all patients will have the same pattern and depth of breathing, how can this be overcome to ensure accurate measurements for all situations?
Field(s) of Study:	Biomedical
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P29**
Supervisor:	Dr Olutayo Oyerinde
Title:	Image processing technique(s) for plant disease detection
Overview:	The project focuses on plant disease detection using image processing techniques. The students are to develop a laptop-based or smart-phone based application that could be used to detect disease that are commonly associated with any of the South African economic plants such as avocados or any other fruits in season during the project period. The students will be required to develop an image processing techniques that can be used as standalone application or could be combined with cloud/remote database. The developed system should be able to isolate the lesions (spots) that can appear on the chosen plants leaves or fruits or both fruits and its leaves. The diagnosis can be based on the numbers of spots, their area and possibly their color features. These will in turn be compared with pre-determined limits in order to select the matching disease. The student can use any suitable freely available software for this project. The students are expected to have solid background in signal and image processing.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P30**
Supervisor:	Dr Xriz Richards
Title:	Electronic stethoscope - design, prototyping and testing development with enhanced functionality
Overview:	Last year (2018) the project titled, "Electronic Stethoscope Design, Prototyping and Testing" was offered for ELEN4002. Its accompanying brief was : "A stethoscope is a tool used to listen for sounds at specific locations. The traditional stethoscope comprises earpieces connected to an audio-conducting tube with a bell and diaphragm at its end. This project requires the design, building and testing of an electronic stethoscope. The design must enhance the audio capability of an acoustic stethoscope, include data logging, and a phonogram." This year (2019), the project offered is an extension of last year's stethoscope. Candidates are to access last year's stethoscope and then improve its functionality through enhancing its data-logging capability and instituting Bluetooth connectivity. To create an application to display and log the stethoscope data on a cellphone can be considered if the aforementioned processes are forthcoming. ----------
Field(s) of Study:	Biomedical
Prerequisites:	Genuine interest and thus, enthusiasm.
Suitable for EE, IE or both:	both

Project ID:	**19P31**
Supervisor:	Dr John Van Coller
Title:	Exploring the functionality of a distance protection relay using a Real Time Digital Simulator
Overview:	For very long transmission lines it is necessary to detect faults by measuring the voltages and currents at one end only. This may work well where the transmission line is part of a simple network. In practice a transmission line is part of a larger network where there may be tee-offs along the line and even a series capacitor along the line. The project will involve simulating a transmission line with various features and faults using a Real Time Digital Simulator and seeing how an actual relay responds to these faults
Field(s) of Study:	Power and Energy
Prerequisites:	ELEN4018A
Suitable for EE, IE or both:	EE

Project ID:	**19P32**
Supervisor:	Dr John Van Coller
Title:	Exploring the functionality of a motor protection relay using a Real Time Digital Simulator
Overview:	A motor needs to be protected against severe operating conditions (producing over temperatures inside the motor) and the external network needs to be protected against a motor with an internal fault. A motor will be simulated with different operating conditions and faults using a Real Time Digital Simulator and the response of a motor protection relay will be analyzed.
Field(s) of Study:	Power and Energy
Prerequisites:	ELEN4018A
Suitable for EE, IE or both:	EE

Project ID:	**19P33**
Supervisor:	Ms Yu-Chieh (Jessie) Yen
Title:	Automated characterisation of heat replacement element pattern of a horizontal geyser
Overview:	Most geysers in South Africa are installed in an horizontal orientation; this has a profound effect on the heat replacement pattern of the geyser element and subsequently the load profile on the electrical grid. For the purposes of modeling the grid loading of horizontal geysers it is therefore necessary to have a set of criteria to measure against with some confidence. The task is to determine such criteria from a set of experiments, which take into account tank size, flow rates, draw volumes, ambient temperatures and inlet temperatures. The set of criteria needs to be determined through robust methodologies. It is intended that a large set of element data can be scanned using this criteria to reverse-engineer the experimental parameters.
Field(s) of Study:	Power and Energy
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P34**
Supervisor:	Mr Shamin Achari
Title:	Media streaming using a Visible Light Communication system
Overview:	Visible Light Communication (VLC) is a form of optical wireless communication where data is transmitted using LEDs or other light sources. VLC is a promising technology used for the downlink in LiFi applications which reduces the load on the radio frequency spectrum. As such, applications where VLC is used to directly stream content is highly sought after. In this project students are required to design, implement and test a media (video/audio) streaming system (receiver and transmitter) which communicates over a VLC channel. The system should be able to run in real-time and make use of a software interface to easily manage and control the streamed content. Media cards may be incorporated into the system to provide the encoding and decoding of the data for transmission. Additionally, the system should preferably make use of the TTL serial protocol to communicate data to and from a computer.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P35**
Supervisor:	Dr Lesedi Masisi
Title:	Low cost position sensor development
Overview:	Position sensors are used in various applications such as conventional and electric vehicles (EV), robotics, industrial processes, etc. Due to the rotor position information advanced and classical control methods can be implemented in order to either control the speed and/or position of instruments. However these position sensors tend to be costly. This project will be concerned with the development of a low cost hall effect position sensor through the use of the AS5045 hall effect sensor. AS5045 Sensor: It is a contactless magnetic rotary encoder for accurate angular measurements over a full 360 turn. It combines integral hall elements, analog front end and digital signal processing. To measure angle/position a simple two pole magnet rotating over the center of the chip is required. What is available? Available is the AS5045 chip and a two pole magnet for the position sensor development. Requirements Here are the requirements for the project: a) The student will be required to design and build a custom PCB and mount all the necessary components for the conditioning and operation of the AS5045 chip. b) Program the chip through a microcontroller in order to obtain the desired output waveforms c) Obtain position information from the sensor d) develop a suitable mounting configuration and possibly an enclosure for the sensor e) conduct testing, analysis and validation of the operation of the encoder. This will lead to a generation of specifications of the developed position sensor. f) Conduct a comparison with a conventional costly position sensor
Field(s) of Study:	Power and Energy
Prerequisites:	Use of micro-controller, Electronics
Suitable for EE, IE or both:	both

Project ID:	**19P36**
Supervisor:	Prof Cuthbert Nyamupangedengu
Title:	Comparative characterisation of corona PD in canola ester oil and in mineral oil
Overview:	Organic oils are now a viable alternative insulation liquid in power transformers because of better properties such as biodegradability, higher flash point and better thermal properties. Defects such as corona in a mineral-oil insulated power transformer can be recognised through diagnostic techniques such as partial discharge measurements. A question arises on how the discharge process changes if the insulation medium becomes ester oils. An experimental investigation is therefore required to compare and contrast corona discharges in mineral oil versus ester oils. The work entails designing a suitable electrode model for simulating corona in a prototype transformer tank and the required PD measurement setup.
Field(s) of Study:	High Voltage
Prerequisites:	None specified
Suitable for EE, IE or both:	EE

Project ID:	**19P37**
Supervisor:	Prof Brian Wigdorowitz
Title:	Constructing a system dynamics model and formulating a control policy to understand and address within limitations the unemployment and poverty problem in a country
Overview:	Many countries have major problems with high unemployment, poverty and increasing gaps between the rich and poor. A useful system dynamics model explaining unemployment and poverty in a country is to be constructed and simulated using published data. The data is to be sourced by the student group. The model and results must explain the reasons for the unemployment and poverty situation in a country. Thereafter a viable control policy is to formulated and tested using the simulation model to address, if possible, the unemployment and poverty problem. Limitations on the model and control effectiveness is to be addressed. The model is to be simulated using Matlab.
Field(s) of Study:	Systems and Control
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P38**
Supervisor:	Prof Cuthbert Nyamupangedengu
Title:	PD detection under impulse voltage
Overview:	While PD detection and measurement under the power frequency and other sinusoidal test voltages is a relatively established technology, the same cannot be said about PD detection under impulse voltage. It has however been established that the degradation effect of impulse voltages (especially those generated in power electronics) is through partial discharge activity. An understanding of the partial discharge characteristics under impulse voltage can therefore inform better insulation design decisions and other insulation problems mitigations. This project therefore is essentially a proof of concept experimentation on PD detection under impulse voltage. The project essentially requires a good literature research to explore how other researchers have implemented the experiments on studying PDs under impulse voltage. A suitable PD detection setup would then need to be designed and implemented. Miniature impulse voltage generators are available in the HV Lab but require refurbishment and calibration; and this will be part of the project tasks. An important aspect of the project is to implement a detection setup with suitable impulse voltage protection for the sensitive measurement instruments.
Field(s) of Study:	High Voltage
Prerequisites:	None specified
Suitable for EE, IE or both:	EE

Project ID:	**19P39**
Supervisor:	Prof Ivan Hofsajer
Title:	Off grid electrification solution
Overview:	A complete, functional residential off grid electrification solution is required for a daily consumption of 150Wh. This will require both a systems level design with user requirements and a component level design implementing the requirements. The engineering objective is to deliver a fully functional prototype that can be used by a third party without the need for intervention.
Field(s) of Study:	Power and Energy
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P40**
Supervisor:	Prof Ivan Hofsajer
Title:	PV sources under non-DC conditions
Overview:	PV panels are normally used under DC conditions and their models are developed under these conditions. It could be that the panels are used under conditions where pulsating AC currents are drawn. For this kind of situation the models do not function well. It is not known how the models should be modified to be able to account for pulsating power conditions. The PV panel model will need to be expanded to include AC effects and experimentally validated.
Field(s) of Study:	Power and Energy
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P41**
Supervisor:	Dr Mercy Shuma-Iwisi
Title:	Electrically assisted waste pickers trolley
Overview:	Waste pickers are key stakeholders in sustainable urban waste management. Millions of people worldwide make a living collecting, sorting, recycling and selling materials that someone else has thrown away. Waste pickers activities alleviate pressure on landfills. The waste economy has enormous potential to create employment as well as entrepreneurial opportunities as evidenced by the Abomakgereza initiative in Johannesburg. A study carried out in 2011 suggests that in South Africa at present there are estimated to be 60,000 waste pickers countrywide. The first task that waste pickers carry out is that of collecting the materials to be recycled. In South Africa this is done in non-motorized trolleys that are pulled by the waste pickers. In any day it is estimated that the waste pickers can walk up to 50 km round trip through different terrains pulling a trolley twice their body weight in the return journey. This is extremely hard and strenuous work. Can there be an engineering solution to alleviate the burden on the waste pickers? The aim of the project is to investigate the feasibility of implementing an electrically assisted waste picker trolley. The investigation will include the following: 1. Determine the different system components that make-up the electrically assisted waste pickers trolley. 2. Gather all the information necessary for the design i.e. distances covered under no load and varied load conditions, size of the load, gradients involved in the trips. 3. Using available information, size up the system components that make it possible to operate the waste pickers trolley successfully over a course of a day. 4. Design, and simulate the subsystems that make-up the electrically assisted waste pickers trolley. It is important that the engineering solution be cost-effective.
Field(s) of Study:	Power and Energy
Prerequisites:	None specified
Suitable for EE, IE or both:	EE

Project ID:	**19P42**
Supervisor:	Ms Jessica Breakey
Title:	Content moderation on social networks
Overview:	Social media networks are flooded with harmful content. Despite technological advancement, content moderation is often left to the human eye with outsourced workers having to manually remove offensive content. Can we streamline/automate content moderation to curb subjectivity and protect workers from harmful images? Students will have to engage debate around free speech, violence and bias.
Field(s) of Study:	Information and Software
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P43**
Supervisor:	Dr Mercy Shuma-Iwisi
Title:	Electricity theft detection in Low Voltage networks
Overview:	Electricity theft is normally categorized as non-technical losses together with fraud and uncollected or defaulted bills. There is a widespread electricity theft in South Africa and distribution utilities such as City power incur non-technical losses of very large magnitude. Finding the source of non-technical losses is challenging. Early research in detection of electricity theft focused on the role of a set of trusted balance meters. In recent years we have seen smart meters deployed in residences as well as in substations. In essence there are huge volumes of data available to the distribution utilities. The high frequency data collection by distribution utilities has made other detection techniques possible with varying degrees of success as well as limitations. The aim of the project is to: 1. Investigate and find out the new detection techniques that have been developed based on smart metering data. 2. Improve and implement the two most appropriate techniques to meet the South African challenge. The techniques should be easy to deploy and computationally efficient. 3. Evaluate the performance of the technique implemented.
Field(s) of Study:	Information and Software
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P44**
Supervisor:	Prof Scott Hazelhurst
Title:	Digital estimation of Body Mass Index
Overview:	Accurately and rapidly measuring weight (and also body mass index the most widely used measure of overweight and obesity) is a critical health issue for children, weights less than expected are a sensitive indicator of current illness or poor nutrition; and for adults being overweight or obese is a clear risk factor for type 2 diabetes and/or hypertension, and/or vascular disease. Inadequate calibration of scales, digit preference and rounding biases, compounded by human error in documenting readings makes it difficult to rely on routinely recorded weights and measures of height and length. Immediate measures of weight to estimate medicine doses or size of equipment are often required in emergency care when it is difficult to obtain a weight of an injured or critically ill patient. Recent releases of cell phone camera based apps that provide a length measure could offer a potential solution for a rapid measure of weight and in the same movement/measure provide height/length. Developing a camera-based measure for inferring or estimating weight and BMI would be a valuable adjunct in several areas of health. For this project we propose the adaption or development of image based measure of height and width (or diameter) at constant anatomic levels to accurately infer body weight. By accurate we would pre-define this as accuracy as within 2% of the calibrated measure. Possible solutions could include the use of a standardised grid/scale background with vertical and horizontal bars, or combining image analysis with electrical impedance measures and comparing measured weight and height with that inferred from an image and other data. This project will be co-supervised by Professor Neil Martinson from the Perinatal HIV Research Unit.
Field(s) of Study:	Information and Software
Prerequisites:	Good software background
Suitable for EE, IE or both:	both

Project ID:	**19P45**
Proposed by Students:	19G17 : James Phillips, Dawood Bade
Supervisor:	Prof Anton Van Wyk
Title:	Indoor patient tracking system using Bluetooth
Overview:	This project aims to investigate the feasibility of tracking a person/patient in a confined environment using Bluetooth. The application of this project aims to assist patients who are dependent on care from a third party, to automate certain processes in a room and provide real time data to care staff on their current whereabouts. The investigation will try to analyse certain objectives, such as: The complexity of using Bluetooth as a tracking method The accuracy of using Bluetooth to track a person or object in a room The costs and technology involved in developing and using such a system and its practicality Available signal processing methods to determine the location of a patient The possibility of House Automation based on a current position Methods of analysing position data, and providing possible outcomes to medical professionals In this project, data is collected from Bluetooth nodes where a patient will have a Bluetooth transmitting device, such as a smartphone, and is relayed to a central point such as a computer. From here, the position is determined using available signal processing techniques, such as possible filter types, and a possible position is determined. Once a position is determined, possible actions could be performed, such as opening a door if the patient is close to a door, turning on lights or turning on appliance. The position data acquired by this system could be used to determine the current situation of a patient. This could be done using a Hidden Markov Model, and providing a real time user interface with position data to medical professionals. This objective is dependent on the amount of time available for implementation
Field(s) of Study:	Systems and Control
Prerequisites:	None specified
Suitable for EE, IE or both:	

Project ID:	**19P46**
Supervisor:	Mr James Braid
Title:	Arc mitigation in Photo-Voltaic systems using passive circuits
Overview:	Despite the simplicity of solar PV systems, the electro-mechanical switching of DC voltages remains a major technical challenge: as the circuit is opened, an arc is typically established across the widening airgap and current continues to flow, as if the switch never existed! This airgap could exist between relay contacts (when being switched intentionally), or between separated conductors / connectors (due to a fault or being inadvertently disconnected). The resultant unwanted arc may result in electrocution to persons, fire damage to property and or electrical failure of equipment. Extensive work has been done in this field and most solutions detect the forming arc via spectral analysis (the arc current being quite EMI-noisy) using sophisticated electronics. Extensive research has also been done into the characteristics under which an arc would sustain itself, or extinguish itself. This project aims to investigate these characteristics, specifically related to PV systems, in an attempt to prevent / extinguish any arcing throughout the system. It is envisaged that perhaps by altering the panels' loading point with passive components, under fault conditions, a potential arc could be self extinguished.
Field(s) of Study:	Power and Energy
Prerequisites:	none but HV would be useful
Suitable for EE, IE or both:	both

Project ID:	**19P47**
Supervisor:	Mr James Braid
Title:	Solar PV cooling using Peltier cells
Overview:	A photo-voltaic cell and a Peltier cell share the same inherent P-N junction, fundamental to their operations; consequently both have very similar circuit models and operating characteristics. Whilst the former produces a potential difference when photons are incident upon it, the latter produces a thermal difference when current flows through it. Being generally expensive, Peltier cells are commonly found in, and have typically been limited to, small portable heating or cooling devices such as car fridges. Since the inherent material is the same, the plummeting price of PV-silicon has resulted in a steady decline in the price of Peltier cells too. With the costs becoming less prohibitive, larger scale cooling using Peltier cells is becoming feasible. This project aims to investigate the mating of photo-voltaic panels with Peltier cells in the application of solar-powered cooling. The project would involve the circuit modelling of both components, determining design equations for sizing purposes, and building a small prototype PV-cooler.
Field(s) of Study:	Power and Energy
Prerequisites:	none but good understand of electronics and thermodynamics is necessary
Suitable for EE, IE or both:	both

Project ID:	**19P48**
Supervisor:	Prof Scott Hazelhurst
Title:	Y-chromosome haplogroup viewer
Overview:	An important tool in understanding human population histories is to be able look at the Y-chromsome DNA since it is only paternally inherited. This allows us to look back into the far past with deep accuracy. This process is known as Y-halpotyoping. New bioinformatics techniques have provided us with new data that can be used for inference, but understanding the data is complex. (A brief overview can be found at http://dept.ee.wits.ac.za/~scott/y.html) This project will develop a visualisation tool that will have two purposes (1) help users to decide which parts of the Y-chromosone should be sampled in a particular project; and (2) help visualise the results. Our research group is particularly interested in developing our understanding of African Y-haplogroups This project does not require any a biological background. The biology background is very straight-forward and can be learned easily. Some references: https://www.le.ac.uk/ge/maj4/JoblingTS.03.NRG.Review.pdf https://www.familytreedna.com/understanding-dna.aspx
Field(s) of Study:	Information and Software
Prerequisites:	Good software background. No molecular biology background needed, but should have an interest
Suitable for EE, IE or both:	both

Project ID:	**19P49**
Supervisor:	Dr Otis Nyandoro
Title:	Linear DC machine controller
Overview:	One of the most basic electrical machines is the linear DC machine(LDC). For this project students are required to design and implement an advanced controller to manipulate the LDC. Advanced control is a automation and control term student s are expected to familiarise with so as to deal with uncertainties and appreciate robustness in modelling and controller design. A cost effective solution is to be developed however advanced controller platforms such as Simulink and DSpace are available.
Field(s) of Study:	Systems and Control
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P50**
Supervisor:	Dr Nick West
Title:	8/20 current impulse generator - waveshape and triggering
Overview:	A current impulse generator is an integral piece of high voltage laboratory equipment. It is used to generate current waveforms that can simulate the effects of direct or indirect lightning strikes. The high voltage laboratory has a combination current impulse generator capable of producing currents of up to 40 kA in current mode with an 8/20 waveform. Students are required to evaluate the condition in which the current generator finds itself. Through the use of a suitable simulation tool, the operation of the generator is to be modelled and new wave-shaping components are to be constructed enabling the production of 8/20 and 4/10 waveforms at current levels up to 40 kA. At the same time strategies for safe triggering of the generator are to be explored, coupled with the suitable electrical protection systems.
Field(s) of Study:	High Voltage
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P51**
Supervisor:	Prof Willie Cronje
Title:	Smart meter for DC energy trading in rural environments
Overview:	There is a need for really cheap but accurate DC energy meters that can be deployed in rural areas for peer-to-peer energy trading in meshed networks supplying DC electricity. This is useful in cases where renewable energy sources and storage are deployed to provide safe and secure electricity in rural areas.
Field(s) of Study:	Power and Energy
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P52**
Supervisor:	Dr Lesedi Masisi
Title:	A guideline and feasibility study on the use of electric buses in the city
Overview:	The air quality within the city tends to be very poor. This is due to the mass usage of transportation system that uses internal combustion engines which emit carbon emissions. The cost of transportation is also affected by fluctuating prices of the fuel prices. This project will be concerned with a feasibility study on the use of electric buses. The focus will be on the conversion of the Wits buses to electric buses. Whats required/Scope: a) Acquire/measure/obtain routes, gradient and distances traveled by the wits buses in transporting students to various places by using a cost effective device/tool. b) Current typical fuel consumption either on a weekly or monthly bases c) Conduct extensive analysis by using a Matlab based tool/package that evaluates performance of different electric drive-train designs d) Develop a technical guideline for the implementation of electric buses within Wits University (city of Johannesburg)
Field(s) of Study:	Power and Energy
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P53**
Supervisor:	Prof Anton Van Wyk
Title:	Machine Learning for discovering video game playing strategies
Overview:	In 2013, DeepMind published Deep Q-Network (DQN), a computer program capable of human-level performance on a number of classic Atari 2600 games. The implemented algorithm played games in exactly the very same way humans do, namely based on its vision of the screen. Upon facing a video game for the first time, it would discover gameplay strategies and then refine its strategies based on its current knowledge and understanding to date in order to develop an even better understanding as time progresses. It was reported that DQN eventually always surpassed human playing skill levels. Work on this has developed over the years with implementations of DQN now migrated to several open source machine learning software systems. The purpose of this project is to demonstrate the ability of machines (specifically standard PCs with Python and open source deep learning packages) to learn the strategies to successfully play some open source video game. Instead of inferring the games state from high level video the machine learning algorithm is required to observe the games state from those variables in the algorithm that represent the games state as portrayed by the video display.
Field(s) of Study:	Systems and Control
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P55**
Supervisor:	Dr Jules Moualeu
Title:	Implementation of a cooperative communication system
Overview:	Cooperative communication is currently being standardized in next-generation wireless local area networks and cellular systems since it can extend wireless network coverage and improve system performance. User cooperation technology allows single-antenna devices to share their physical resources by creating a virtual antenna array. In this project, the students are required to implement a cooperative communication system through a decode-and-forward approach using software-defined radios. The project involves the transmission of information from a source node to a destination node.
Field(s) of Study:	Telecommunications
Prerequisites:	Communications Systems
Suitable for EE, IE or both:	both

Project ID:	**19P56**
Supervisor:	Dr Jules Moualeu
Title:	Implementation of Turbo Codes on FPGA
Overview:	Turbo codes are a class of forward error correction (FEC) codes with performance close to the Shannon theoretical limit. These codes which have revolutionized error-correction coding due to their high performance, are widely used in 3G/4G mobile communications (for e.g. in UMTS and LTE). The aim of this project is to design and implement a turbo-coded system using field programmable gate arrays (FPGA). This project involves the transmission of source information through the implemented system. Interested groups should have a good background in communication systems and be savvy in Linux and microprocessors.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P57**
Supervisor:	Mr Adam Pantanowitz
Title:	Have a Brain Tweet
Overview:	Previously we were able to achieve through-brain propagation of strings of characters by utilising SSVEP (flashing lights encoded with information), and EEG measurements (think passive brain network). The system had a fairly low information transmission rate. We want to take this further this year, by integrating this with Twitter, to allow a tweet to propagate and be sent through the brain visually (passively). Automated submission of the tweet through Twitter's API via some brain trigger would rock. To do so, we will need to change the type of signal encoding used, and improve the bandwidth. We'll be walking on the shoulders of giants to do so (Daya, Dukes, 2017). This is a demanding project and thus will require a skillset and understanding of telecommunications, signal generation, encoding and processing (analogue and software), and other modern magic. Should time allow, we will look at evoked potentials to re-manufacture a tweet encoded in audio (though this is not a firm requirement of the project, but it's "on my mind").
Field(s) of Study:	Biomedical
Prerequisites:	Software dev 3. Biomed & Telecommunications not required, but helpful
Suitable for EE, IE or both:	both

Project ID:	**19P58**
Supervisor:	Dr Nick West
Title:	Use of image processing to estimate fermentation rate during beer production in the Wits Microbrewery
Overview:	In beer production the rate of fermentation is usually determined using offline laboratory analysis, this provides a challenge, especially for small scale producers as problems with batches may only be detected when it is too late to rectify, resulting in off-spec product. In the context of beer brewing, fermentation is the conversion of sugars into carbon dioxide and ethanol (alcohol). This conversion is performed through the use of brewing yeast at suitable conditions. The rate of fermentation is linked to the rate at which carbon dioxide is produced. The resulting carbon dioxide vented from the fermentation vessel can be bubbled through water and monitored with a camera. Image processing software can then be used to determine the size of these bubbles and the rate at which they are produced. This will allow students to create a low cost gas flow meter, which can be used to estimate the fermentation rate occurring within the fermenter.
Field(s) of Study:	Electronics
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P59**
Supervisor:	Ms Yu-Chieh (Jessie) Yen
Title:	Big Data load profile analysis of 5.4M geysers
Overview:	Heat replacement models for vertical geysers are well established, but horizontal geyser models have received less attention because they are less widely used worldwide. However, in South Africa, the preferred tank orientation is horizontal and therefore should be incorporated into any aggregated load profile analysis to address some wider questions about loading on the electrical grid. The task is to explore scenarios that determine the load contribution of geysers in both horizontal and vertical orientation with a clear set of assumptions made in each case; factors to consider are the proportion of horizontal to vertical, tank size, draw volumes, flow rates, various temperatures and time of use. The simulation of 5.4 million geysers in several scenarios will require clever data management and processing techniques.
Field(s) of Study:	Power and Energy
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P61**
Supervisor:	Prof Estelle Trengove
Title:	Identikit functionality for Khwezi sexual assault app
Overview:	Last year a 4th year group developed an app called Khwezi to assist survivors of sexual assault. The app allowed the survivor to capture the details of the incident. The app used the incident reports to create a map showing sexual assault hotspots. Perpetrators of sexual assault are often serial perpetrators, so the app was also meant to use an algorithm to compare survivor stories to identify serial perpetrators. Last years group implemented a very simplistic tree search algorithm. This year, you will be required to implement a much more complex machine learning algorithm to identify serial offender. You will also have to add functionality that allows a survivor to create a facial identikit of the perpetrator by selecting facial features from a palette of features.
Field(s) of Study:	Information and Software
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P63**
Supervisor:	Prof Fambirai Takawira
Title:	Neural network based automatic modulation identification
Overview:	Modulation type is a characteristic that is required by a receiver in order to correctly decode the transmitted data. One of the widely used modulation type is multilevel quadrature amplitude modulation (MQAM). Recent wireless communication standards specify use of adaptive MQAM schemes where the modulation order changes as the channel condition changes. It therefore becomes necessary for the receiver to identify the modulation level in real-time as it changes from frame to frame. A number of techniques have been proposed in the literature for identification of MQAM signals. Essentially the problem involves determining the modulation level used in the MQAM. Neural networks are powerful tools for parameter identification. This project involves the design and implementation of a real-time MQAM identification system using neural networks. The project involves derivation of an appropriate identification technique and an appropriate neural network structure. The chosen scheme should be implemented in a system that operates in real-time.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both

Project ID:	**19P64**
Supervisor:	Prof Fambirai Takawira
Title:	Image compression based on non-parametric sampling in noisy environments
Overview:	In image compression we transmit as little of the image data as possible, as long as the full image can be recovered at the receiver. One of the techniques proposed for data compression of images involves transmitting the image with holes which are then filled at the receiver through pattern matching. The original image is recovered by exploiting the structure of the original image. The receiver needs to determine the size of the holes and appropriate filling data. A number of techniques have been proposed for this, but in almost such work, it is assumed that the received image is not subject to significant errors. For images transmitted through wireless channels, the bit errors at the receiver could be substantial. This project involves the derivation of a robust scheme for determining multiple holes in a received image which is also subject to random and burst bit errors.
Field(s) of Study:	Telecommunications
Prerequisites:	None specified
Suitable for EE, IE or both:	both