MODULE EE4020
PROJECT DESCRIPTIONS
(PROVISIONAL)
2006-2007

This booklet contains **provisional** project titles and descriptions for module EE4020 – Project, for the academic year starting September 25th 2006.

Students should note that this is NOT a complete or final list, and therefore the specific project titles and descriptions are only *indicative* of the type of projects available from each member of staff.

Students should also note that the inclusion of a project title or description in this booklet does not imply that the supervisor(s) *must* accept students for that project; neither does the number of projects offered by a member of staff imply that they will take on that total number of students. Several staff members have listed project details for more students than they will eventually take, in order to increase the choice of topics available.

Students should note that Dr. Gordon Lightbody is on sabbatical leave until January 2007, and so will not be offering any projects this year. Students with an interest in Control Engineering should be aware that many of the projects offered by other members of staff have a significant control engineering content.

There may also be other staff members in the Tyndall Institute or other academic departments who are prepared to take on project students this year, but who are not listed in this booklet.

Students should note that projects will NOT be allocated until week 2 of teaching Period 1, until which time all students should gather as much information as possible regarding their projects of interest.

Any projects that are industrially sponsored or projects that are a continuation of work placements have also been included in this booklet. Students should note that these will reduce the number of other project students taken on by the relevant staff member.

Dr. Bill Wright
Module Coordinator EE4020 – Project
22/09/2006

Project Title:	**An ultrasonic anemometer for Mars exploration**
Supervisor(s):	Dr. Bill Wright
No. of Students:	2
Project Location:	Ultrasonics Research Laboratory, 1st Floor EEE Building
Project Description:	Europe's next Mars lander (the ExoMars rover, due for launch in 2011) requires a wind sensor capable of measuring 3D wind vectors and other atmospheric information. Conventional vane-type anemometers are too unreliable due to atmospheric dust, and conventional piezoelectric ultrasonic anemometers will not work due to the low temperatures (160K-300K) and the low pressure CO_2 atmosphere (5-10mbar) on Mars. An anemometer based on capacitive ultrasonic transducers may offer the only viable alternative, provided that it can operate with the following additional constraints: very low mass (<50 g), small size, low power consumption, and resistance to shock and vibration (about 10*g*). This project requires the design, construction and evaluation of a suitable ultrasonic anemometer using capacitive transducers.
Special Requirements:	This project would suit two very hard working students with a keen interest in developing skills in sensors, software, hardware, signal processing and general electronics.

Project Title:	**FIRA Mirosot robot soccer**
Supervisor(s):	Dr. Bill Wright
No. of Students:	4 minimum – see special requirements below
Project Location:	Mechanical Laboratory, Ground Floor EEE Building
Project Description:	http://www.fira.net/soccer/mirosot/overview.html
Special Requirements:	This is an *extremely* tough and challenging engineering project that requires a SERIOUS amount of hard work and dedication, and it has the potential to be a complete disaster. Therefore, this project will be withdrawn unless the students can demonstrate that (a) they each have sufficient technical ability, and (b) they can work together as a team and all pull their weight, otherwise they will probably end up killing each other before the project ends. Late nights and working at weekends are quite likely if you want this project to succeed. If you are looking for an enjoyable project, go for something else. Analogue electronics, software, image processing, sensors, and robotics skills will have to be developed to a very high standard; please note that previous football experience is NOT an advantage. In the highly unlikely event that a viable Mirosot robot football team is produced, it may be entered into the 2007 European competition, and so the potential reward is large.

Project Title:	**Characterization of capacitive ultrasonic transducer MEMs**
Supervisor(s):	Dr. Bill Wright
No. of Students:	1 or 2
Project Location:	Ultrasonics Research Laboratory, 1st Floor EEE Building; Tyndall
Project Description:	A range of new MEMs (micro electro-mechanical systems) that can generate and detect ultrasonic waves in air have been

	manufactured in the Tyndall Institute under their National Access Plan (NAP). These miniature ultrasonic transducers are capacitive in nature and consist of a substrate electrode over which a small supported metal membrane electrode is allowed to deflect, generating or detecting ultrasonic waves. The frequency response and sensitivity of these devices is determined by the membrane geometry and μm-scale features patterned into the substrate electrode. This project will require electrical characterization of the devices, modelling their theoretical response, determination of the most critical geometric factors, and experimental testing. The design of the next generation of devices will also be investigated as time allows.
Special Requirements:	This project would suit patient and hardworking students who must be able to pay very close attention to detail as the devices are small (hundreds of μm), and have an interest in MEMs devices or microelectronics. Some of the testing will take place in the Tyndall Institute.

Project Title:	**Mach-Zehnder interferometry of ultrasound in air**
Supervisor(s):	Dr. Bill Wright
No. of Students:	2
Project Location:	Ultrasonics Research Laboratory, 1st Floor EEE Building
Project Description:	A Mach-Zehnder interferometer may used to measure changes in the optical refractive index of transparent fluids caused by variations in density, temperature and pressure. It may also be used to visualize air flow around objects. This project requires the design and construction of a Mach-Zehnder interferometer for characterizing the ultrasonic wavefronts produced in air from capacitive ultrasonic transducers.
Special Requirements:	This project requires two patient, diligent and hard working students with a close attention to detail. Skills in optics, sensors, software and electronics will be developed.

Project Title:	**Ultrasonic tomographic reconstruction from diffracting sources**
Supervisor(s):	Dr. Bill Wright
No. of Students:	1 or 2
Project Location:	Ultrasonics Research Laboratory, 1st Floor EEE Building
Project Description:	Ultrasonic tomography is a medical imaging method by which ultrasonic signals transmitted through the human body may be used to reconstruct an internal cross sectional image of a particular acoustic property such as tissue stiffness, density, or temperature. The ultrasonic data are usually acquired using a single ultrasonic transmitter and an array of detectors, producing fan-shaped datasets. Standard reconstruction algorithms based on Fourier theory may be used to form basic images, but as ultrasonic waves diffract, a non-standard Fourier-based algorithm should be used to achieve more accurate reconstructions. There are also suitable iterative algorithms such as algebraic reconstruction technique

	(ART) and simultaneous iterative reconstruction technique (SIRT). This project will involve the generation of simulated data, and development and testing of suitable reconstruction algorithms in MATLAB®. Real ultrasonic data from tissue-mimicking materials ("phantoms") may be acquired to further test the algorithms as time allows.
Special Requirements:	This project requires exceptional students with excellent mathematical and programming skills. Taking modules EE4012 Medical Electronic Systems and EE4008 Digital Signal Processing would be an advantage, but is not essential.

Project Title:	**A charge-pump bias control circuit for avalanche photodiodes**
Supervisor(s):	Dr. Alan P. Morrison
No. of Students:	2
Project Location:	Quantum Electronics Research Lab., 1st floor EEE Building
Project Description:	Avalanche photodiodes are typically biased close to their breakdown voltage to obtain maximum gain by impact ionisation. The typical breakdown voltage normally exceeds the voltage levels available in standard CMOS electronics by up to a factor of 10. The purpose of this project is to develop suitable bias control architectures to allow effective operation of an APD with a 30V breakdown using only a 3.3V dc supply.
Special Requirements:	The students undertaking this project will require a very good grounding in analogue circuit design

Project Title:	**PIC-based control of a photon-counting detector**
Supervisor(s):	Dr. Alan P. Morrison
No. of Students:	2
Project Location:	Quantum Electronics Research Lab., 1st floor EEE Building
Project Description:	To operate effectively a Geiger-mode avalanche photodiode must be continuously monitored for avalanche breakdown. Upon breakdown the device needs to be switched off for a predetermined duration, a counter recording the avalanche event is incremented and the device is then reset to its quiescent state to await the next avalanche event. This project will involve developing a microprocessor based control system to monitor the effective operation of the GM-APD, record the avalanche events and provide a display of the operating statistics.
Special Requirements:	Students with an interest in microprocessor based hardware design and applications oriented system development will find this project interesting and challenging.

Project Title:	**High speed imaging of golf-ball impact**
Supervisor(s):	Dr. Alan P. Morrison
No. of Students:	2
Project Location:	Quantum Electronics Research Lab., 1st floor EEE Building
Project Description:	The impact between a golf club and ball lasts less than a millisecond and provides a challenging application for high speed imaging of this event. This project will involve the design and

	implementation of a suitable high speed imaging system to measure the ball compression, speed and spin at and just after impact. The camera available for this task will be a simple 640 x 480 CMOS camera with a maximum framerate of 30 f/s.
Special Requirements:	This project will suit two students with an interest in sensors, imaging, electronic circuit design and software development

Project Title:	**A complete golf-swing analyser**
Supervisor(s):	Dr. Alan P. Morrison
No. of Students:	2
Project Location:	TBD
Project Description:	This project will build on a similar project from last year. The students will be required to add to the software developed in last year's project, incorporate a more appropriate video signal for the swing capture, introduce new features and an improved user interface.
Special Requirements:	The work will suit two students with an interest in biomechanics, software development and hardware integration. The existing software is written in C++, but the students may decide to start from scratch.

Project Title:	**Hybrid Noncoherent/Differentially-Coherent Combining Detector for Weak Signal GPS Acquisition**
Supervisor(s):	Dr. Colin Murphy
No. of Students:	2
Project Location:	Digital Communications Laboratory, 2nd Floor EEE Building
Project Description:	The Global Positioning System (GPS) was designed with outdoor use in mind. Consequently, when GPS receivers are embedded in mobile phones (required by European Directive E112) to enable emergency services to locate an ill user (e.g. heart attack victim), a technical challenge arises. In particular, indoor GPS signals are often very weak (can be as low as –180 dBW) and their successful detection and processing presents a significant design challenge. This project will develop a hybrid signal acquisition unit that, depending upon signal strength, automatically selects between noncoherent and differentially coherent combining detector forms, according to a suitably derived optimisation algorithm. Appropriate simulations (C++/Mathematica) will be developed to guide the design process and the resulting receiver architecture will be captured either in VHDL (targeting an FPGA) or on a suitable DSP microprocessor.
Special Requirements:	Keen interest in signal processing, related mathematics and implementation characteristics.

Project Title:	**HPC Implementation of WPM Symbol Error Analysis**
Supervisor(s):	Dr. Colin Murphy
No. of Students:	2
Project Location:	Digital Communications Laboratory, 2nd Floor EEE Building
Project Description:	HPC (High Performance Computing) refers to cluster-based

	parallel programming i.e. the use of multiple processors working together on a common task. Due to the high computational overhead usually involved in Wavelet Packet Modulation (WPM) Bit-Error Rate (BER) evaluation, traditional serial programming (i.e. single processor) implementation is sometimes infeasible. Furthermore, even when approximating the BER, estimation of the optimal modulator configuration on a single processor is only possible up to 4 levels of Wavelet Packet decomposition (given current standard processor specifications). This project seeks to capitalise on the computational potential offered by the recently developed, state-of-the-art BCRI (Boole Centre for Research in Informatics) computer cluster to analytically evaluate WPM BERs previously thought infeasible.
Special Requirements:	Keen interest in parallel computation/signal processing.

Project Title:	**Subband Adaptive Equalisation of Time Varying Channels**
Supervisor(s):	Dr. Colin Murphy
No. of Students:	2
Project Location:	Digital Communications Laboratory
Project Description:	Recent research results indicate that subband adaptive equalizers exhibit performance comparable to that of traditional least mean squares (LMS) equalizers, but with significantly reduced implementation costs. The goal of this project is to develop a VHDL-based implementation of a subband adaptive equalizer (targeting FPGAs) and to subsequently explore the implementation cost/performance profile of the approach. In addition to developing a hardware-based version, the project team will also validate their understanding/results via the development of a suitable simulation (Mathematica).
Special Requirements:	Keen interest in signal processing, related mathematics and implementation characteristics.

Project Title:	**Windpower Doubly-Fed Induction Generator Power and Control**
Supervisor(s):	Dr. John Hayes
No. of Students:	2
Project Location:	Power Lab
Project Description:	Large windpower generators commonly feature doubly-fed (aka slip-ring or wound-rotor) induction machines for the electromechanical energy conversion. The students will research, build and test the power electronics and control for a DFIG-based windpower system. Interested students will be interested in wind power systems, specifying and testing electric drives, building power electronics, using microprocessors/DSPs for control.
Special Requirements:	

Project Title:	**Windpower Inverter**
Supervisor(s):	Dr. John Hayes
No. of Students:	2

Project Location:	Power Electronics Lab
Project Description:	The integration of wind power into the grid poses many problems for power systems. In this project, the dc link, generated by the squirell-cage or permanent-magnet motor rectifier, will be inverted to generate three-phase for integration into the grid. This project will research and build a three-phase dc-ac inverter for this application. Interested students will be interested in wind power systems and simulating, building, and testing power electronics and magnetics.
Special Requirements:	

Project Title:	**HVLV Bidirectional Converter**
Supervisor(s):	Dr. John Hayes
No. of Students:	2
Project Location:	Power Electronics Lab
Project Description:	Many advanced energy systems interface energy sources such as fuel cells and internal combustion engines to high-voltage dc links. A bidirectional power converter interfacing to a low-voltage battery is often necessary. This project will research and build a bidirectional HV-LV power converter. Interested students will be interested in alternative energy systems and simulating, building, and testing power electronics and magnetics.
Special Requirements:	

Project Title:	**System and Circuit Architectures for UltrawideBand (UWB) Transceivers for Sensor Networks**
Supervisor(s):	Dr. Kevin McCarthy
No. of Students:	2
Project Location:	Teltec Lab/CAD Room, 2nd Floor EEE
Project Description:	UltrawideBand (UWB) Communications which makes use of frequencies between 3.1 and 10.6GHz is gaining rapid deployment in short-range applications such as Personal Area Networks (PANs) for high speed wireless data transfer between a host computer and peripherals such as multi-media entertainment devices. They are also being deployed for low-data rate, low-power applications such as sensor networks. This computer-based project will identify and simulate suitable architectures and circuits for a basic ultrawideband transceiver based on existing publications.
Special Requirements:	This project is most suited to students who intend to take the 4th year module EE4011, RF IC Design.

Project Title:	**Reader/Writer Electronics for Commercial RFID Tags**
Supervisor(s):	Dr. Kevin McCarthy
No. of Students:	2
Project Location:	Teltec Lab/CAD Room, 2nd Floor EEE
Project Description:	Radio Frequency Identification (RFID) has become firmly established in several areas such as building access control, automobile tolling and transport ticketing systems. Anyone passing through the London Underground recently will probably have used

	the RFID-based "Oyster card". This project will investigate a commercial RFID system and determine if home-grown circuit designs and programs can be developed to detect and perform read/write operations on commercially available RFID tags.
Special Requirements:	This project is most suited to students who intend to take the 4th year module EE4011, RF IC Design.

Project Title:	**Investigation of ZigBee® Sensor Network Platforms**
Supervisor(s):	Dr. Kevin McCarthy
No. of Students:	2
Project Location:	Teltec Lab/CAD Room, 2nd Floor EEE
Project Description:	ZigBee® is a new standard developed by the Institute of Electrical and Electronics Engineers (IEEE) for low-power sensor networks. Low-power wireless sensor networks are becoming very popular as the communications link for applications such as lighting and heating control, security systems and some medical monitoring. This project will demonstrate the use of commercial ZigBee® devices by deploying a sample ZigBee® network in the EEE building.
Special Requirements:	This project is most suited to students who intend to take the 4th year modules EE4004 (Telecommunications) or EE4011 (RF IC Design).

Project Title:	**GSM Control of a SmartHome Using a PSoC®**
Supervisor(s):	Dr. Kevin McCarthy/Deirdre deBhailis
No. of Students:	2
Project Location:	Teltec Lab/CAD Room, 2nd Floor EEE
Project Description:	Home automation and control by means of GSM text messages is of interest to many people with holiday homes or who travel frequently. This concept was demonstrated a few years ago in EEE but required a PC or laptop computer to control the operation, which increases the expense and reduces the reliability of the system. This project will implement a SmartHome system using a PSoC® (Programmable System on Chip) which is a versatile IC from Cypress Semiconductors and contains a CPU for program execution and an analogue front-end suitable for monitoring temperature and sensor conditions in the SmartHome.
Special Requirements:	This project will appeal to students who like a mixture of hardware and software. If the project is successful, it is planned to make the resulting SmartHome a "permanent exhibit" to be used on Engineering and Science Open Days at UCC.

Project Title:	**Implementation of Hodgekin-Huxlex Neuron Model in an Electronic Simulator**
Supervisor(s):	Dr. Kevin McCarthy
No. of Students:	1 or 2
Project Location:	Teltec Lab/CAD Room, 2nd Floor EEE
Project Description:	Biochip technology is slowly moving from early concepts to real implementations. One recent development is the growth of small

	collections of neural cells on top of CMOS circuits where the CMOS is used to sense the firing events of the neural cells and monitor the potential cascades through the neural networks. For efficient design, models of the neurons, especially regarding their firing mechanisms, will need to be incorporated into normal electronic CAD systems, This project will take the neuron firing model developed by Hodgekin and Huxley in the 1950's and implement it in a suitable simulator such as Matlab/Simulink or VHDL-AMS. Once implemented, the model will be used to simulate small neural networks and hopefully their interaction with CMOS.
Special Requirements:	It is desirable that the student(s) taking this project would also take the 4th year module, EE4012 (Medical Electronic Systems)..

Project Title:	**RFID Passport**
Supervisor(s):	Dr Liam Marnane
No. of Students:	2
Project Location:	DSP Laboratory
Project Description:	It is proposed to used Radio Frequency Identification technology along with the storage of Biometric data in future Passports. When swiped across an electronic reader, the chip in the passport wirelessly transmits data to a customs officer's computer screen. The object of this project is to construct a RFID passport and reader and to investigate the security (cryptography) requirements such that the data is protected against unauthorised access and interception.
Special Requirements:	

Project Title:	**Auditory processing of English words as indexed by the mismatch negativity (MMN)**
Supervisor(s):	Dr Liam Marnane & Dr Catharine Pettigrew (Dept. of Speech & Hearing Sciences, UCC)
No. of Students:	2
Project Location:	DSP Laboratory
Project Description:	An auditory event-related potential called the “mismatch negativity” (MMN) can be used to investigated the automatic auditory processing of speech and tones in normal individuals and individuals with aphasia following a stroke. The MMN is calculated from the EEG signal taken from individuals whose hearing is stimulated by words or tones. The aim of this project is to implement in Matlab the signal processing steps to calculate the MMN. EEG data already collected in the Dept. of Speech & Hearing Sciences is available for use in this project.
Special Requirements:	

Project Title:	**Artefact Rejection in EEG signals**
Supervisor(s):	Dr Liam Marnane
No. of Students:	2
Project Location:	DSP Laboratory

Project Description:	The automatic processing of EEG signals is complicated by the presence of artefacts such as eye or muscle movements in the signal. The aim of this project is to develop signal processing techniques to automatically detect and remove the artefacts. Techniques such as Independent & principle component analysis and signal modelling will be used. EEG data already collected in the Dept. of Paediatrics & Child Health is available for use in the project.
Special Requirements:	

Project Title:	**Torque measuring system for a hydraulic motor**
Supervisor(s):	Dr. S.M. De Almeida
No. of Students:	2
Project Location:	Mech Lab. -1st Floor
Project Description:	The present hydraulic motor test rig has a mechanical type of torque application & measuring device. The aim of the project is to change the configuration to an electrical/electronic system. This will involve the design/construction of the torque applicator and the torque measuring system. Areas of interest: sensors, electronics, mechanical design
Special Requirements:	

Project Title:	**Volume fraction analysis through image processing**
Supervisor(s):	Dr. S.M. De Almeida
No. of Students:	2
Project Location:	Mech. Lab 1st Floor
Project Description:	In a material consisting of different phases (or different components), it is sometimes necessary to determine the volume fraction of each component. This can be done by taking a micrograph of the material and taking measurements manually and calculating the volume fraction. This project will investigate the possibility of using image analysis to automate the process.
Special Requirements:	

Project Title:	**High Power DC/DC Converter Automotive Applications**
Supervisor(s):	Dr. Michael Egan
No. of Students:	2
Project Location:	Power Electronics Research Laboratory, Ground Floor EEE Building.
Project Description:	The growing acceptance of the impact of carbon dioxide emissions on global weather patterns and the finite nature of oil reserves has led to a massive research and development effort into hybrid-electric vehicles with low emissions and high fuel efficiency. A key component in the electrical architecture of these vehicles is a high power dc/dc converter with ratings in excess of 100 kW. The design of this converter is based on a complex optimisation of the circuit topology and its operating frequency, passive components such as inductors and capacitors, and the selection of power semiconductor switching devices. For high power and high

	frequency, the Insulated Gate Bipolar Transistor, (IGBT) is the power device of choice. This project is an investigation of the application of these devices in the design of automotive hybrid-electric dc/dc converters with particular emphasis on soft switching operation.
Special Requirements:	This project is for two enthusiastic students with an interest in gaining experience across a broad range of electronic hardware development, including power devices, gate drive circuits, magnetic component design and general purpose analogue and digital electronics.

Project Title:	**Design and Development of a SCADA System for an Electrical Machine Test Rig**
Supervisor(s):	Dr. Michael Egan
No. of Students:	2 students
Project Location:	Power Electronics Research Laboratory, Ground Floor EEE Building.
Project Description:	The electrical power network is based almost entirely on the three-phase system of generation, transmission and distribution of balanced three-phase sinusoidal ac voltages. This process requires the use of three-phase synchronous generators and transformers which can be connected in a variety of configurations to suit the voltage, current and power requirements at any given point in the grid. The operation of the electrical network is based on widespread Supervisory Control And Data Acquisition (SCADA) systems which monitor and report critical operating parameters such as voltage, current, frequency, real and reactive powers etc. The objective of this project is to design, construct and test an electrical generator, configurable three-phase transformer and three-phase load system, with an appropriate PC-based data acquisition system to emulate the operation of a small-scale grid-connected synchronous generator.
Special Requirements:	This project is for two highly motivated students with a significant interest in power engineering, electrical machines and transformers. However, the project is broadly based and will also require skills in computer networking, programming and general electronics. The SCADA system will be based on a Merlin Gerin power monitoring data acquisition unit

Project Title:	**Power Converter Modelling**
Supervisor(s):	Dr. Michael Egan
No. of Students:	2
Project Location:	Power Electronics Research Laboratory, Ground Floor EEE Building
Project Description:	In the past decade, power electronic converters have become critical components in a vast range of consumer and industrial products, ranging from mobile phones and personal computers to industrial motor drive systems and electric vehicles. The design of

	such systems is a highly complex task and increasing emphasis is being placed on specific computer aided modelling tools to facilitate the design process. As yet, there is no consensus on the platform which may is best suited for this application and it is interesting to consider the merits and demerits of a range of possible contenders, such as Matlab/Simulink, Labview, PSpice and also potentially Mathematica. This objective of this project is to assess these packages as the basis for modelling power converters and to develop a simple power-converter prototype board with a computer-controlled USB interface for hardware demonstrations.
Special Requirements:	This project requires two hard working students with a flair for software development. The project will also require hardware design skills and the ability to undertake the hardware/software interface.

Project Title:	**Solid State Film to Video Transfer**
Supervisor(s):	Prof. Patrick Murphy
No. of Students:	2
Project Location:	Teltec Lab – 2nd Floor
Project Description:	The aim of this project is to construct a self-contained unit which will convert movie film material (16mm or Super 8) into high resolution video. Whilst there are various commercial products available which already perform this function they are usually either very poor quality or prohibitively expensive. This project aims to exploit recent price reductions and improvements in quality in image sensor technologies to build a high-quality unit at modest cost. If the project were completely successful the resultant product may have some commercial value.
Special Requirements:	Students would be required to have an aptitude for practical construction and testing. The project is strictly "hands-on" and will look very well on the open day if it works – and pretty disastrous if it doesn't.

Project Title:	**On Line Real Time Energy Information System**
Supervisor(s):	Prof. Patrick Murphy
No. of Students:	2
Project Location:	Teltec Lab – 2nd Floor
Project Description:	UCC has recently installed a comprehensive monitoring system for its energy consumption (primarily electricity, but gas and water usage are also monitored). The UCC Energy Committee wishes to make this information available to the College administrators and general community through an on line real time system.
Special Requirements:	Students will be required to have an aptitude for energy management systems and the ability to implement a web-based information system which draws on data-base sources.

Project Title:	**Laser based anemometer**
Supervisor(s):	Dr. Sean Prunty

No. of Students:	2
Project Location:	Laser Research Laboratory
Project Description:	This is an optics based project which sets out to investigate the design and construction of a laboratory based instrument for the determination of fluid velocity remotely. In short, a laser system projects an optical fringe pattern in the vicinity of the velocity flow and a detector system looks for backscattered radiation at a frequency proportional to the flow rate. Student opting to take on this project are expected to undertake a thorough analysis of the technique prior to considering the design and construction of a prototype instrument.
Special Requirements:	Two dedicated students are required with good mathematical abilities and excellent laboratory skills. Compliance with all laser safety procedures is mandatory.

Project Title:	**Design of a Nitrogen Laser**
Supervisor(s):	Dr. Sean Prunty
No. of Students:	2
Project Location:	Laser Applications Laboratory
Project Description:	The purpose of this project is to design a nitrogen laser for general laboratory use. However, the trick in designing a working laser is to pay careful attention to the design of the power supply for exciting the nitrogen molecules. A very fast excitation at high voltage is required otherwise the laser will not work. Therefore, the student undertaking this project will be expected to spend some time designing the power supply before construction a working laser.
Special Requirements:	Excellent engineering design skills are a requirement as well as tidy laboratory practices. Compliance with all safety procedures in relation to lasers is mandatory. Students must take the EE4007 module.

Project Title:	**A Carbon Dioxide Marking Laser**
Supervisor(s):	Dr. Sean Prunty
No. of Students:	2
Project Location:	Laser Applications Laboratory
Project Description:	The purpose of this project is to become familiar with typical laser machine tools used in an industrial setting and to carry out tests on a range of materials. The system contains a fully integrated computer controlled galvanometer-scanning head. Host communication is via serial RS232 and the system incorporates a Laser CAD program. It is recommended that the students undertaking this project should take Optical Electronics (EE4007) option and be interested in laser systems and how they are integrated into an industrial machine tool. In addition, the student should have good computing skills and above all be interested in the project and be willing to devote the time necessary to achieve excellent familiarity with the system. The following milestones in relation to the project are anticipated:

	• An appreciation of the laser system and all of its component parts. • Compliance with all safety matters in relation to lasers and to the safe running of the system. • Familiarization with the Laser CAD software.
Special Requirements:	Excellent software skills are a requirement for this project.

Project Title:	**DSP-based Acceleration Measurement of Rotating Systems**
Supervisor(s):	Dr. Richard Kavanagh
No. of Students:	2
Project Location:	Mechatronics Research Laboratory
Project Description:	Acceleration measurement is becoming increasingly important in the high-bandwidth control of machines and robots. The project considers the development of new algorithms for improved acceleration estimation of such motion control systems. In these systems, discrete (quantized) position is available from angular position sensors such as incremental encoders. The project will concentrate on two methods by which acceleration can be estimated (1) By designing and implementing a suitable FIR filter that processes the digital position information (initially on a DSP, but with possible transfer to FPGA; and (2)) based on the time-stamping (using an FPGA circuit) of the position transitions, a potentially higher estimation performance can be obtained (i.e. through the development of an algorithm that utilizes both position and time information to effectively minimize the effect of position quantization). In the latter case, a combined FPGA/DSP approach is envisaged. The implementation of a new DSP/FPGA interface will be needed. The project will rely heavily on the design, simulation and implementation of new DSP algorithms, starting from basic mathematical principles. Skills developed: (Principal) DSP programming, Algorithm development, C, (Also) Digital circuit design, FPGA hardware, Working with servosystems, encoders, sensors, etc., for test systems, Algorithm development, Matlab.
Special Requirements:	