Projects for 2011-12

Title	Optimisation of fabrication techniques for scaffolds used in diffusion based bone tissue engineering
Supervisor Name	Kevin O'Kelly (KOK1)
Student	
Description	A recurring limitation of scaffolds is that bone forms only in the outer 250 µm – 500 µm region. This is likely due to insufficient nutrient transport and metabolic waste removal. By improving mass transfer at the construct periphery and within its internal pores, bone tissue engineering scaffolds show great promise and commercial viability. This work investigates the effect manufacturing design parameters on the diffusion behaviour and mechanical behaviour of a novel scaffold.
Pre-requisites	
EM suitable	No
Other information	50-50 split between experimental and computational work.

Title	Development of test to measure the stab resistance of personal body armour
Supervisor name	Kevin O'Kelly (KOK2)
Student	
Description	The effectiveness of materials typically used in personal body armour (e.g. Kevlar) will be assessed. This project deals with the development of a test to assess the threat from knives that are typically of high quality and feature very sharp machine-ground cutting edges and fine points as well as the threats from ice picks and lower quality, prison-made knives and shivs will are much more difficult to quantify.
Pre-requisites	
EM suitable	Yes
Other information	Experimental

Title	Prototype design of a novel micro-electrode for neural engineering applications
Supervisor name	Kevin O'Kelly (KOK3)
Student	
Description	Artificial devices implanted into the central nervous system initiate cell loss and trigger inflammatory response which results in the encapsulation of the device with scar tissue. This inhibits the device from physically and electrically interacting with the neurons. The material and size of the electrode is highly influential. This project will try and develop a 25 nm diameter electrode capable of being inserted and fixed to the brain with very accurate spatial positioning.
Pre-requisites	
EM suitable	Yes
Other information	Experimental

Title	Development of functionally graded materials for wind turbine applications
Supervisor name	Kevin O'Kelly (KOK4)
Student	
Description	New designs in large wind turbines improve energy capture at lower wind speeds. The new designs allows the blade to twist more than traditional designs, thus relieving some of the effects of gusty turbulent wind on blade life. This then allows longer blade length for the same rotor, providing for increased energy capture and greater commercial viability. Composite materials offer huge advantages in terms of strength to weight ratios. However, sharp transitions between component materials cause stress and strain discontinuities that facilitate fracture. Functionally graded materials are fabricated to provide gradually changing material properties. This project investigates how these types of materials may be applied to turbine blades.
Pre-requisites	
EM suitable	Yes
Other information	Experimental & Computational

Title	Synthesis and characterisation of nano-sized biocompatible ceramic powders using the sol-gel technique
Supervisor name	Kevin O'Kelly (KOK5)
Student	
Description	Biomaterials are key to preventing scar tissue from forming. A novel approach is to use a sol-gel glass technique. As an initial step this project will develop the capability of producing nano-sized particles of hydroxyapatite in the TCBE and evaluating the effect of particle size on the mechanical properties (and possibly the biocompatibility) of microcrystalline ceramic materials fabricated from these powders.
Pre-requisites	
EM suitable	No
Other information	Experimental

Title	Effect of multiple pressings on the properties of dental bioceramics (lithium disilicate)
Supervisor name	Kevin O'Kelly (KOK6)
Student	
Description	Lithium disilicate is a glass ceramic commonly used for dental prostheses (e.g. crowns). The material is expensive and produced in small billets that are heated and pressed into a mould. The remainder, often 80% of the original quantity, is discarded. This project will investigate the crystallographic and phase changes that occur and the consequences for mechanical properties when the remaining material is subjected to subsequent pressings in order to see if the use of the discarded material is viable.
Pre-requisites	
EM suitable	Yes
Other information	Mostly experimental work

Title	Copula-based Modeling for rare event prediction
Supervisor Name and Code	Kevin Kelly – KK1
Description	Many areas of engineering involve monitoring or diagnostics – the purpose of which is to recognize when faults have occurred and to provide useful information about the nature of these faults, while minimizing the harmful consequences. An example is tool condition monitoring – where sensors are used to infer whether or not a cutting tool in a machining process is worn or broken. The 'holy grail' in such situations is to be able to predict imminent breakage. However a major complicating factor is the number of influences on the sensor signals, which significantly complicates interpretation and makes the development of robust monitoring strategies extremely complicated. Sensor fusion is one possible solution, but has been complicated by the high degree of correlation between sensor signals, and the stochastic influences mentioned. A copula is a mathematical construct which allows (Sklars' Theorem) a multivariate, correlated distribution to be decomposed into a number of independent univariate distributions, which are 'coupled' with the copula function. This technique offers considerable potential for the problem of rare event prediction. This project will explore the possibility of using this approach in the domain of tool condition monitoring, and will build on expertise in the manufacturing research group
Pre-requisites	Strong Mathematical ability. MATLAB/programming skills would also be advantageous
Is it suitable for a BSc student (YES/NO)	Yes

Title	Development of a Game-playing Robot
Supervisor Name and Code	Kevin Kelly – KK2
Description	This project will follow on from a previous project which succeeded in building a simple robotic hand connected to a web-cam and laptop, so that a human could engage the computer in a game of 'rock-paper-scissors'. The constructed robot has proved very successful at showcase events such as open days, Young Scientists etc in attracting potential students to consider a career in engineering. This project will seek to advance the capability of the existing design in the following areas: • Incorporation of an elbow joint • Faster and more human-like motion of the joints • More robust algorithm for detection of the opponents hand 'sign' • Incorporation of game-theoretic strategy for the robots chosen options

Pre-requisites	Some ability in programming would be useful
Is it suitable for a BSc student (YES/NO)	Yes

Title	Object Tracking for Mobile Robots
Supervisor Name and Code	Kevin Kelly – KK3
Description	Traditionally, the primary focus of robotics research has been on the development of industrial robots. These robots typically perform highly repetitive, pre-programmed actions such as welding joints, moving objects and packaging to name a few. However in recent years, improvements in computer technologies and developments in artificial intelligence and control have led to a new and exciting breed of robots being developed. Unlike their predecessors, these machines are highly autonomous and capable of high levels of mobility. This project will involve developing and building a control system that will be used on a mobile robot and will enable the robot to track a specific object in an unknown environment.
Pre-requisites	None
Is it suitable for a BSc student (YES/NO)	No

Title	The Hairdryer game
Supervisor Name and Code	Kevin Kelly – KK4
Description	The lack of interest in engineering and technology amongst school students is a significant problem for the Irish economy. Anecdotal evidence, however, suggests that when the nature and scope of engineering is explained to students that their interest is piqued considerably. The problem therefore would appear to be one of promotion/marketing. Concurrently, many studies have shown that game-based learning is an extremely effective paradigm where players can absorb considerable quantities of information almost subliminally. This has prompted the development of an online multi-player/team game putting players in charge of a manufacturing company making hairdryers. There are strong superficial similarities between many management games (typically used in MBA/business programs) and also with commercial games such as The Sims, SimCity and Farmville. The differentiating feature in this game is that it integrates engineering questions into the decision making process. This project will follow on from a project this year which defined a basic game concept and obtained user feedback from the target market.
Pre-requisites	Programming and/or web-design experience would be a significant advantage
Is it suitable for a BSc student (YES/NO)	Yes

Title	ATTRACT The Attractiveness of Engineering
Supervisor Name and Code	Kevin Kelly – KK5
Description	Ireland, in common with most OECD countries in the western world has a shortage of applicants qualified and willing to enter third-level engineering programmes. This has potentially very serious consequences for the Irish economy, particularly if we retain any ambitions to be a 'smart island' (whatever that may be!). This project will involve working with a team working on a European wide project aimed at diagnosing the causes of this problem and recommending appropriate remedial action. Tasks will include designing, testing and documenting specific initiatives to encourage engineering as a career choice for primary and secondary school students.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes

Title	Cutting Optimisation in LOM rapid prototyping

Supervisor Name and Code	Kevin Kelly – KK6
Description	Rapid prototyping is a collective term that refers to a range of technologies that can be used to produce aesthetic or functional prototypes, or in certain cases, actual functional components. Laminated object manufacturing (LOM) is one such method that works by gluing sheets of paper together before cutting excess material away, to leave a 3D component of the desired geometry. There is considerable scope for improvement in cycle times however, and this project will focus on this issue, by addressing one or both of the following topics: a) design of better path control algorithms to reduce cutting time between layers b) optimization of gluing and cutting for waste material areas in each layer The project will involve liaising with a manufacturer of LOM machines. The project will follow on from a current project and will focus, in part at least, on the 3D representation of shapes and their manipulation.
Pre-requisites	Programming ability, good spatial visualization. Some mathematical aptitude
Is it suitable for a BSc student (YES/NO)	Yes

Title	Low Cost rapid 3D scanner for rapid prototyping operations
Supervisor Name and Code	Kevin Kelly – KK7
Description	There are many applications where it is required to generate a computer surface/mesh model of a physical object. Typically this is accomplished by using a 3D scanner – most of which work by placing the object on the rotating table and using a CNC controlled laser to scan the object to build up a point cloud model of the surface from which the appropriate mesh model can be generated. There are many disadvantages to this method, such as: • High noise, leading to inaccurate or unnecessarily detailed surface models • Slow scanning times • Small object footprint • Inability to scan anything that won't fit inside the scanner enclosure This project will investigate the possibility of constructing a cheap and flexible setup using low-cost cameras (probably web-cams) arranged in an array, and design and implementation of appropriate software code to process the individual images and 'stitch' them together to form an

	appropriate three-dimensional model of the object.
Pre-requisites	Programming ability
Is it suitable for a BSc student (YES/NO)	Yes

Title	Biomimetic nanocomposite scaffolds for lung tissue engineering
Supervisor Name and Code	Biqiong Chen (BC1)
Description	Synthetic tissue scaffolds play a crucial role in regenerative medicine. This project aims to develop biomimetic polymer nanocomposite scaffolds by freeze drying and investigate their structure and function to assess their potential performance as lung tissue scaffolds. Experimental techniques will involve freeze-drying, FT-IR SEM, Micro-CT and mechanical testing.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes

Title	Nanofibrous membranes for cardiovascular tissue engineering
Supervisor Name and Code	Biqiong Chen (BC2)
Description	Mimicking the fibrous structure in native tissue is proven to be important in tissue engineering. This project aims to replicate the fibrous structure in cardiovascular organs/tissues such as hearts or blood vessels by electrospinning, and study the structure and properties of the nanofibrous membranes. Experimental techniques will involve electrospinning, FT-IR, SEM, Micro-CT and mechanical testing.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	No

Title	Novel tissue scaffolds
Supervisor Name and Code	Biqiong Chen (BC3)
Description	This project aims to prepare tissue scaffolds with optimized pore structures and hierarchical structures of nanofibres by a novel approach and evaluate the structure and properties of the scaffolds for potential applications in tissue engineering. Experimental techniques will involve freeze-drying, electrospinning, FT-IR, SEM, Micro-CT and mechanical testing.

Pre-requisites	
Is it suitable for a BSc student (YES/NO)	No

Title	Nanoplatelet-reinforced hydrogels for engineering applications
Supervisor Name and Code	Biqiong Chen (BC4)
Description	Hydrogels are crosslinked polymers in the presence of a large fraction of water. They are very useful in soft tissue engineering and drug delivery. This project will prepare hydrogels via the use of nanoplatelets to form strong and tough hydrogels for uses as soft machines and soft tissues as well as for replacement of rubbers in engineering. Experimental techniques will involve Raman Spectroscopy, XRD, freeze-drying, FT-IR, SEM, Micro-CT and mechanical testing.
Pre-requisites	Interest in chemical reactions would be beneficial to the project.
Is it suitable for a BSc student (YES/NO)	No

Title	Double-functionalised hydrogels for drug delivery
Supervisor Name and Code	Biqiong Chen (BC5)
Description	This project will prepare electrically and pH responsive hydrogels by using graphene (a one-atom-thick planar sheet of carbon atoms) and a pH sensitive biopolymer as potential controlled systems for drug delivery. Experimental techniques will involve freeze-drying, SEM, mechanical testing, electrical testing and in vitro drug dissolution testing.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	No

Title	Smart polymer nanocomposites
Supervisor Name and Code	Biqiong Chen (BC 6)
Description	Smart materials that can change their properties "on command", such as shape-memory polymers and smart gels, have recently generated great interest in engineering community and beyond. This project will develop light-responsive mechanically adaptive polymer-cellulose nanocomposites and study their structure, mechanical properties and light responsive behavior.
Pre-requisites	Interest in chemical reactions would be beneficial to the

	project.
Is it suitable for a BSc student (YES/NO)	Yes

Title	**Effect of yaw in heat exchanger tube bundles**
Supervisor Name and Code	Dr. Meskell CM1
Description	In this project we will use uRANS to model the effect of tube yaw on unsteady fluid forces. The basic idea is that placing successive rows of tubes at an angle relative to the preceding row will destroy spanwise correlation and so dramatically reduce the size of t he unsteady fluid forces. Thus, the most dangerous mechanisms associated with flow-induced vibration in heat exchangers will be eliminated (i.e. fluidelastic instability and vortex shedding). The low frequency turbulence levels will almost definitely be increased, but this may in fact be beneficial as the increased mixing may aid heat transfer. In the later stages of the work, we will have to include heat transfer in the simulations to test this question. A preliminary study has demonstrated the effect for the simple case of 2 tubes. This project would start with two tubes, but would rapidly move to the much more geometrically complex case of a tube bundle. This project is based completely on numerical simulation.
Pre-requisites	3B2 Fluid Mechanics
Is it suitable for a BSc student (YES/NO)	No

Title	**Investigation of shadowing in wave energy farms**
Supervisor Name and Code	Dr. Meskell CM2
Description	For wave energy devices to be commercially viable they will have to be deployed as farms. In this project the interference effect of these devices will be investigated. The optimal spacing will be investigated for ideal and real sea states using assumed transfer functions for the devices. This project will be achieved completely through simulation and will involve substantial computer coding and theoretical analysis.
Pre-requisites	3B2 Fluid Mechanics
Is it suitable for a BSc student (YES/NO)	No

Title	**Simulation of unsteady flow around wind turbine blades at very high angles of attack.**
Supervisor Name and Code	Dr. Meskell CM3
Description	Even when wind turbines are not generating power they are

	subject to the wind. Certification of new designs must consider the possibility of large winds (a "100 year" wind) coming from any direction. This project will investigate the vortex shedding characteristics of a typical wind turbine section at very high angles of attack so that the aerofoil shape is effectively a bluff body. This project will use unsteady RANS and so is completely based on simulation using a commercial computational fluid dynamics software.
Pre-requisites	3B2 Fluid Mechanics
Is it suitable for a BSc student (YES/NO)	No

Title	**Determining the feasibility of locating aeroacoustic sound sources in ducted flows using only microphones.**
Supervisor Name and Code	Dr. Meskell CM4
Description	Many engineering systems involve flow in pipes and ducts. Heat exchangers, process plant and HVAC installations are a few examples. If the fluid is a gas, then a strong flow induced acoustic resonance may develop. In this project the feasibility localizing the sound sources using the wave expansion method (WEM) coupled with microphone array techniques will be investigated. This project will be largely numerical in nature, using Matlab as the coding environment, with the possibility of some experimentation in the latter stages.
Pre-requisites	3B2 Fluid Mechanics
Is it suitable for a BSc student (YES/NO)	No

Title	**Experimental investigation of the surface pressure distribution in heat exchanger tube arrays.**
Supervisor Name and Code	Dr. Meskell CM5
Description	In this project the surface pressure in a tube array, indicative of those found in large scale thermal power plants, will be measured using test facilities and equipment already developed in TCD. The effect of tube displacement and spanwise correlation will be investigated. An indication of the nature of the experimental work can be found in: Mahon, J. and C. Meskell, *Surface pressure distribution survey in normal triangular tube arrays.* Journal of Fluids and Structures, 2009. **25**: p. 1348-1368.
Pre-requisites	3B2 Fluid Mechanics
Is it suitable for a BSc student (YES/NO)	No

Title	**Simulation of acoustic resonance in a gas pipeline junction.**

Supervisor Name and Code	Dr. Meskell CM6
Description	Many engineering systems involve flow in pipes and ducts. Heat exchangers, process plant and HVAC installations are a few examples. If the fluid is a gas, then a strong flow induced acoustic resonance may develop. Experience has shown that a T junction may exhibit strong flow induced acoustic resonance. In this project the flow will be simulate using unsteady RANS and coupled with the acoustics using the Howe equation. This project is based completely on simulation and will require considerable coding and analysis. Details of the system to be modeled can be found at: Ziada, S. McLaren, K.W. Li, Y. *Flow-acoustic coupling in T-Junctions: Effect of T-Junction geometry*Journal of Pressure Vessel Technology, Transactions of the ASME, v 131**(4**), p 0413021-04130214, August 2009
Pre-requisites	3B2 Fluid Mechanics
Is it suitable for a BSc student (YES/NO)	No

Title	Bouncing bubble dynamics and heat transfer
Supervisor Name and Code	Darina Murray (DM1)
Description	Convective heat transfer between a liquid and a heated or cooled surface can be enhanced by the motion of gas bubbles in the flow. In the current work, a small air bubble rises through a tank of water and bounces off a horizontal surface. The proposed research will use high speed cameras to study the bubble bouncing behaviour while fast response IR imaging is used to measure the local heat transfer characteristics associated with the bouncing phenomenon. The main objective will be to explore the effect of bubble rise distance and bubble diameter on heat transfer.
Pre-requisites	4B4
Is it suitable for a BSc student (YES/NO)	No

Title	Synthetic jet pairs for cooling electronics components
Supervisor Name and Code	Darina Murray (DM2)
Description	Synthetic or pulsating air jets have great potential as an enhanced cooling technique for high power density applications such as microelectronics. The interaction between

	adjacent synthetic jet flows can be used to draw in fresh air, thus eliminating the need for a cross-flow fan. The aim of this project is to experimentally characterise a pair of synthetic slot jets in terms of convective heat transfer rate. The work will investigate the effect of jet spacing, nozzle shape and phase difference on the surface heat transfer to identify optimal heat transfer modes. The research will use infrared thermography to measure surface temperature and may involve flow measurements using particle image velocimetry.
Pre-requisites	3B2
Is it suitable for a BSc student (YES/NO)	Yes

Title	Pulsed jet heat transfer
Supervisor Name and Code	Darina Murray (DM3)
Description	Stationary impinging jets are a well-known technique for obtaining high rates of cooling, e.g. for power electronics or manufacturing applications. Nevertheless, substantial enhancements of the heat transfer performance of up to 200% have been reported for unsteady flow, e.g. by using a pulsating on/off jet. This is due to enhanced entrainment, mixing and more effective break-up of the thermal boundary layer. Pulsed jets behave differently than synthetic oscillating jets and they target different applications, however some interesting comparisons can be made with synthetic jet research in our lab. The aim of this project is to experimentally characterise a pulsed round impinging jet in terms of convective heat transfer rate. The work investigates the effect of Reynolds number, jet to surface spacing and pulsation characteristics (e.g. frequency, waveform) on the surface heat transfer to identify optimal heat transfer modes.
Pre-requisites	4B4
Is it suitable for a BSc student (YES/NO)	No

Title	Microjet heat transfer
Supervisor Name and Code	Darina Murray (DM4)
Description	Arrays of impinging air jets provide effective cooling for many engineering applications and have been proposed as a solution for electronics cooling systems. Such systems require very compact cooling solutions and thus it is necessary to use micro jets. One aspect of micro jet flows is that the flow is highly compressible and this changes the jet temperature appreciably. This project will modify the existing rig to allow for accurate determination of the adiabatic wall temperature and will use high resolution IR thermography to determine the heat transfer characteristics of arrays of jets in the 100 to 900 micron diameter range.
Pre-requisites	4B4
Is it suitable for a BSc student (YES/NO)	No

Title	Natural convection heat transfer for pairs of horizontal cylinders
Supervisor Name and Code	Darina Murray (DM5)
Description	The proposed research will investigate free convection flow and heat transfer for horizontal cylinders in water. Tests will be conducted for 2 or 3 horizontal cylinders, located in the same horizontal plane but at variable spacing. Both time-averaged and time resolved heat transfer measurements will be made, and the work may include whole field flow measurements using PIV. A specific objective of this project will be to investigate the effect of neighbouring plume interactions and oscillations on heat transfer.
Pre-requisites	4B4
Is it suitable for a BSc student (YES/NO)	No

Title	Heat transfer to a plume of rising bubbles
Supervisor Name and Code	Darina Murray (DM6)
Description	The introduction of air bubbles into a liquid flow can enhance convective heat transfer between the liquid and a heated or cooled surface. This effect is partially due to thermal conductance changes and partially due to the enhanced mixing induced by the bubble motion through the liquid. The proposed research will use hot film sensors to measure local heat transfer characteristics on a heated vertical plate located in a water tank and which is subject to flow past by a plume of rising bubbles. The main objective will be to determine the effect of the inter bubble interval on the enhancement of heat

	transfer.
Pre-requisites	4B4
Is it suitable for a BSc student (YES/NO)	No

Title	Repair of Bone Defects
Supervisor Name and Code	David Taylor (DT1)
Description	Holes occur in bones as a result of accidents, diseases, etc. Surgeons repair these defects by filling the holes in with bone substitute materials. New substitutes are being developed by tissue engineering. In a previous project we showed that, theoretically, the substitute material does not have to be as good as the original bone, to prevent premature failure. This work was published (Brazel E and Taylor D (2009) "Predicting the structural integrity of bone defects repaired using bone graft materials" *Computer methods in biomechanics and biomedical engineering* 12:297-304). However this theory has never been tested experimentally. This project will involve mechanical testing of bone to establish its fatigue behaviour in samples containing defects, with and without substitute materials of different kinds.
Pre-requisites	Bioengineering and Materials
Is it suitable for a BSc student (YES/NO)	NO

Title	Pykrete: Reinforced Ice as an Engineering Material
Supervisor Name and Code	David Taylor (DT2)
Description	Pykrete is a composite material made by mixing ice and wood. See http://en.wikipedia.org/wiki/Pykrete. The material has been shown to be much stronger than normal ice and could be interesting as an engineering material, at least in very cold places! This project will investigate the material experimentally, measuring various properties such as toughness and creep behaviour, and relating these to the material's composition and the properties of its constituents. Up to two people can work on this project. For BSc students the project could consider commercial aspects such as costs, marketing, applications etc.
Pre-requisites	Materials
Is it suitable for a BSc student (YES/NO)	YES

Title	Pykrete: Reinforced Ice as an Engineering Material
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Pre-requisites	Materials
Is it suitable for a BSc student (YES/NO)	YES

Title	Insect Cuticle: Fatigue and Repair
Supervisor Name and Code	David Taylor (DT4)
Description	Insects' bodies are made from a material called cuticle. Similar material is used to make the bodies of other arthropods such as crabs and lobsters. Nobody has ever measured the fatigue strength of this material. Fatigue is important to the insects, of course, and understanding the properties of natural materials like this can help us to design new engineering materials. The project will involve measuring fatigue life and fatigue crack propagation rate in cuticle taken from locusts, and studying how the insects repair damage. It will be relevant to students interested in Bioengineering and in Materials.
Pre-requisites	Bioengineering and Materials
Is it suitable for a BSc student (YES/NO)	NO

Title	Fracture of Wood
Supervisor Name and Code	David Taylor (DT5)
Description	The fracture strength of materials is often reduced by the presence of stress concentration features such as holes and notches. Calculating the effect of such features is quite difficult. We have developed a new way of doing it – see for example (Taylor D (2008) "The Theory of Critical Distances" *Engineering Fracture Mechanics* 75:1696-1705). Our approach has been tested on many materials, but so far not on wood, which of course is an important structural material. This project will involve carrying out fracture tests on samples of wood, comparing the effect of various types of holes and

	notches. The results will then be compared to predictions made using our theory; the work will involve experimental testing and computer modelling using finite element analysis.
Pre-requisites	Materials
Is it suitable for a BSc student (YES/NO)	NO

Title	Bamboo as an Engineering Material
Supervisor Name and Code	David Taylor (DT6)
Description	Bamboo is a natural material which is used extensively for structural purposes in Asia, and increasingly in Ireland and other countries. This project will investigate the microstructure and mechanical properties of bamboo and its different failure modes (splitting, buckling etc). It will be compared with other engineering materials (steel, carbon fibre, etc). This project will be relevant to people interested in Bioengineering and/or in Materials; it will involve a mixture of experimental work and theoretical analysis.
Pre-requisites	Materials
Is it suitable for a BSc student (YES/NO)	NO

Title	How does the spatial distribution of the extracellular matrix within tissue engineered cartilage influence its apparent mechanical properties?
Supervisor Name and Code	Daniel Kelly (DK1)
Description	Articular cartilage has a limited capacity for repair. This has led to increased interested in engineering replacement tissues to repair damaged cartilage. This involves seeding cells onto scaffolds, and subjecting these cell seeded constructs to the appropriate signals that promote tissue formation. Research in our lab has shown that the spatial organization of these tissues is often inhomogeneous, with greater matrix accumulation directly around cells. The objective of this project is to use finite element modeling to investigate how the spatial organization of extracellular matrix around engineered tissue influences its apparent mechanical properties. This project will of interest to a student looking for a project that involves computational modeling.
Pre-requisites	4B1, 4B16
Is it suitable for a BSc student (YES/NO)	No

Title	Strain mapping of tissue engineered cartilage under compression
Supervisor Name and Code	Daniel Kelly (DK2)
Description	The function of articular cartilage is to transmit loads from one bone to another. Understanding how it achieves its function requires understanding the unique mechanics of the tissue. The tissue is known to possess depth dependant mechanical properties. Recapitulating these depth dependant properties in tissue engineered cartilage is critical to success. The objective of this project is to develop a methodology to quantify how the mechanical properties of tissue engineered cartilage vary through its thickness by mapping the strain in the tissue during compressive loading. Cells within the tissue will be labeled with a dye, so that they can be used as markers to track deformation in the tissue. Images will be taken of the tissue during compression using a microscope. The objective of the project is to use a previously MATLAB code to quantify the local deformation within the tissue during compression. This will be of interest to a student looking for a project that combines solid mechanics and tissue engineering.
Pre-requisites	4B1, 4B16
Is it suitable for a BSc student (YES/NO)	NO

Title	Development and characterisation of porous scaffolds containing drug eluting particles for cartilage repair
Supervisor Name and Code	Daniel Kelly (DK3)
Description	A paradigm shift has taken place in modern regenerative medicine from using synthetic implants and tissue grafts to a tissue engineering approach that uses degradable porous material scaffolds integrated with biological cells or molecules to regenerate tissues. Recent advances in cartilage repair have shown that functional cartilaginous tissue can be generated using mesenchymal stem cells (MSCs) in conjunction with media supplemented with growth factors such as transforming growth factor-beta 3 (TGF-β3) and/or basic fibroblastic growth factor (FGF-2) [1]. The proposed work will investigate the incorporation of drug eluting microparticles produced through an emulsion-solvent technique into porous biomaterials which will be fabricated through the freeze-drying method. The project deliverable will be a series of scaffolds of varying hydrogel concentration with differing functional properties and pore morphologies.
Pre-requisites	4B1, 4B16
Is it suitable for a BSc student (YES/NO)	NO

Title	Design and development of a hydrostatic pressure bioreactor
Supervisor Name and Code	Daniel Kelly (DK4)
Description	Articular cartilage has a limited capacity for repair. This has led to increased interested in engineering replacement tissues to repair damaged cartilage. This involves seeding cells onto scaffolds, and subjecting these cell seeded constructs to the appropriate signals that promote tissue formation. Hydrostatic pressure has been shown to be a key signal for promoting cartilage matrix production. The objective of this project is to design and build a hydrostatic pressure bioreactor that can fit in a standard tissue culture incubator. The ability to control the magnitude and frequency of hydrostatic pressure is a key design criterion.
Pre-requisites	4B1
Is it suitable for a BSc student (YES/NO)	Yes

Title	Anatomically shaped tissue engineered grafts
Supervisor Name and Code	Daniel Kelly (DK5)
Description	Engineering cartilaginous tissues *in vitro* with clinically relevant dimensions and of appropriate geometry is a significant challenge in the field of Tissue Engineering. The objective of this project will be to development of anatomically accurate moulds of the entire cartilaginous region of an articular surface for use in cartilage tissue engineering. MRI and micro-CT will be used to determine the geometry of the cartilaginous and bony regions of the patella (knee cap), from which the moulds will be fabricated. Agarose suspensions will then be cast into these moulds, and the geometry of the constructs compared to the original tissue.
Pre-requisites	4B15
Is it suitable for a BSc student (YES/NO)	Yes

Title	Finite element modelling of oxygen and nutrient consumption in tissue engineered cartilage
Supervisor Name and Code	Daniel Kelly (DK6)
Description	There has been increased interest in utilising mesenchymal stem cells (MSCs) for cell-based cartilage repair therapies. MSCs derived from the bone marrow have attracted significant attention for cartilage therapy development. Incorporating such cells into scaffolds or hydrogels represents a promising strategy for engineering cartilaginous grafts. During the *in vitro* development of these tissues, the cells within the tissues consume oxygen and nutrients, creating

	spatial gradients in these regulatory factors through the engineered tissue. Oxygen tension would appear to play a key role in regulating chondrogenesis during tissue development and regeneration. Low oxygen tension has been shown to promote cartilage specific extracellular matrix (ECM) production. The objective of this project is to develop a model of oxygen and nutrient consumption within tissue engineered cartilage. A commercial finite element package will be used.
Pre-requisites	4B16
Is it suitable for a BSc student (YES/NO)	No

Title	Finite element modeling of gel and gel-skin indentation for TRULIFE cushion product evaluation
Supervisor Name and Code	Dr Ciaran Simms (CS1)
Description	Trulife (http://www.trulife.com) is an Irish multinational company which manufactures a range of medical devices. The R&D group in Tallaght is responsible for the design of their range of pressure relief cushions. These are formed using a combination of silicon gel, air voids, a polyurethane "skin" and foams. The design process follows a strict procedure however testing and validation of this type of products' performance could be enhanced with computational modeling. Innovation and advancement in testing techniques has been slow in this industry. In this project a simplified finite element model of a rigid indentor compressing the cushion will be used to understand the relative contributions of the silicone gel and the polyurethane skin to the effective stiffness of the cushion.
Pre-requisites	Biomechanics, good programming ability
Is it suitable for a BSc student (YES/NO)	Yes

Title	Finite element modeling of foam compression to predict tool shape for compression cutting for Trulife cushion products
Supervisor Name and Code	Dr. Ciaran Simms (CS2)
Description	Trulife (http://www.trulife.com) is an Irish multinational company which manufactures a range of medical devices. The R&D group in Tallaght is responsible for the design of their range of pressure relief cushions. These are formed using a combination of silicon gel, air voids, a polyurethane "skin" and foams. The products include a sculpted foam base designed to match the shape of the human buttocks. The sculpted foam shape is achieved by compressing the foam

	through a piece of Plaster of Paris tooling and the compressed foam is then passed through a bandsaw. At present, the design of the tooling is an in-house developed procedure. The function of the tooling is subject to variation due to the many material and machine parameters involved and the potential for computational modeling to inform the design process is clear. In this project finite element modeling of the foam compression will be used as a first step to develop a transfer function between the tool shape and the resulting sculpted foam shape.
Pre-requisites	Good programming ability
Is it suitable for a BSc student (YES/NO)	Yes

Title	Finite element modeling of heat transfer characteristics in replacement breast products
Supervisor Name and Code	Dr. Ciaran Simms (CS3)
Description	Trulife (http://www.trulife.com) is an Irish multinational company which manufactures a range of medical devices. The R&D group in Tallaght are responsible for the design of a breast care product range. The products are designed to be used following mastectomy (surgical removal of a breast to remove a malignant tumor), and are manufactured using a combination of silicon gel and a polyurethane "skin". The silicone has poor heat transfer characteristics, and a new range of products is designed to improve the heat transfer from the chest for active users by using alternative materials embedded within the silicone to act as partial cooling fins and to provide airflow between the chest and the breast form. The design process follows a strict procedure however testing and validation of this type of products' performance could be enhanced with computational modeling. Innovation and advancement in testing techniques has been slow in this industry. In a previous project a simplified finite element model of the heat transfer characteristics of the existing designs was developed and validated using an experimental protocol. In this project, the model will be used as a design tool to help identify prosthesis designs with improved heat transfer characteristics. The final improved design will be constructed and evaluated experimentally I compared to existing designs.
Pre-requisites	Good computer modeling ability and understanding of heat transfer
Is it suitable for a BSc student (YES/NO)	Yes

Title	Evaluation of seat foam pressure transfer functions using two sets of pressure measurements for Enable Ireland SeatTech
Supervisor Name and Code	Dr. Ciaran Simms (CS4)
Description	Enable Ireland is one of the two largest providers of services to people with physical disabilities in Ireland. SeatTech is the custom mobility and seating service within Enable Ireland. The primary function of SeatTech is to provide seating and mobility assessments and subsequent equipment selection, prescription, design and manufacture. Pressure mapping systems are used at SeatTech to aid in the prescription of seating systems for individual clients. These pressure maps consist of a matrix of load cells spread over a flexible membrane which is placed between the body and the seat during sitting, and SeatTech currently has two pressure mapping sensor arrays. The map provides a measure of pressure intensity and pressure gradients. Nonetheless, these pressure mapping systems are currently used more in a qualitative manner than in a quantitative manner. In this project, the two pressure mapping sensor arrays will be used to quantify the cushioning effect of different cushion designs. This will be done by performing simplified indentor tests on cushioning systems in which the pressure mapping sensor arrays will be placed at different axial locations. The goal is to use the pressure maps to quantify the advantages/disadvantages of different cushion designs in this manner.
Pre-requisites	Good experimental ability and Matlab programming
Is it suitable for a BSc student (YES/NO)	No

Title	Multibody modelling of pedestrian windscreen contact: the influence of pedestrian gait and speed on optimum windscreen angle for head protection
Supervisor Name and Code	Dr Ciaran Simms (CS5)
Description	This project will use multibody modelling methods to investigate the relationship between vehicle windscreen design and linear and rotational acceleration induced head injuries over a range of human gait positions and walking speeds. This project will address the angle of the windscreen and the friction of the head/windscreen contact using state-of-the-art computational modelling techniques. This project will build on a previous project which developed a validated vehicle pedestrian model and found that, for a single gait stance, linear and angular accelerations of the head are reduced by increasing the angle of the windscreen.
Pre-requisites	Good knowledge of Mechanics and good programming ability
Is it suitable for a BSc	No

student (YES/NO)	

Title	Finite element modeling of human muscle tissue during impact : the influence of muscle behaviour on bone loading
Supervisor Name and Code	Dr Ciaran Simms (CS6)
Description	This project will use finite element modeling methods to investigate the relationship between muscle constitutive behavior and bone loading during impact. The human body is comprised of almost 50% muscle tissue, and internal organs and bone loading due to external contacts are mediated by the compressive behavior of muscle tissue. This project will use the freeware FEBio program to model a simplified muscle bone complex during impact to determine the relative influence of muscle mechanical properties on bone loading. The constitutive models for muscle will be based on experimental data available through the research group at Trinity College Dublin.
Pre-requisites	Good knowledge of Mechanics and good computer programming ability
Is it suitable for a BSc student (YES/NO)	No

Title	Reconstruction of transverse motorcycle accidents
Supervisor Name and Code	Dr Ciaran Simms (CS7)
Description	Impact speed is the key determinant for injury risk for any impact scenario and legal limits mean that establishing the pre-impact speeds of motor cycles, cars etc is required for litigation purposes. However, the existing forensic methods for prediction of motorcyclist pre-impact speeds in cases where the motorcycle collides with the side of a vehicle are limited. Recent work has proposed the use of residual deformation of the motorcycle wheelbase to predict pre-impact speed, but this method is not always applicable, especially when motorcycle components have completely fractured. Furthermore, the damaged motorcycle is frequently unavailable for analysis. **Hypothesis**: The projection distance of struck motorcyclists can be used to predict motorcyclist pre-impact speed in transvers collisions with passenger cars. **Goal:** Develop methods of predicting motorcycle pre-impact speed from motorcyclist projection distance, with a range of statistical confidence limits. **Method:** A combination of single segment and particle representations of the motorcyclist will be used to relate the motorcyclist projection distance to the impact velocity, and Monte Carlo methods will be used to account for uncertainties. The predictive capability of the model will be assessed by comparison with staged accident data and with a Madymo computational model.

	Experimentation: this will be a modelling project using Madymo and Matlab
Pre-requisites	Good knowledge of Mechanics and good programming ability
Is it suitable for a BSc student (YES/NO)	No

Title	Design, development, and testing of a durable finger prosthesis.
Supervisor Name and Code	Bruce Murphy (BM1)
Description	Currently one-piece silicone finger prostheses have a relatively short lifetime *in vivo*. A simple design change can substantially increase the lifetime of a prosthesis. During this project the student will redesign and manufacture a new prosthesis. Subsequently this prosthesis will be statically and dynamically tested to determine: 1. The structural stability of the new design 2. The fatigue life of the new design The results of this study will be compared to a base case and used to promote the new design to orthopaedic implant manufacturers..
Pre-requisites	4B15, 4 B16, 4B2
Is it suitable for a BSc student (YES/NO)	Yes if the above subjects are chosen as final year options.

Title	Measurement of the inter-operator variability of the pressure induced by a venous ulcer bandaging procedure
Supervisor Name and Code	Bruce Murphy (BM2)
Description	The treatment for venous ulcers is to tightly bandage the lower limb to aid venous function. However highly variable clinical results are observed during this process. Currently there is no simple method available to measure the pressure induced during the bandaging process. In this project the student will develop a simple methodology for measuring the pressure induced by venous bandaging. The method will initially be verified in a lab based set-up and subsequently validated on patients in St James's Hospital's Veins Unit.
Pre-requisites	4B15, 4B16 and the student must contact me prior to the summer break to ensure that the administrative tasks are put in place in a timely manner (e.g. submission of ethics approval forms)
Is it suitable for a BSc student (YES/NO)	Yes

Title	Development of a tool to remove potential embolic fragments post carotid stenting
Supervisor Name and Code	Bruce Murphy (BM3)
Description	Carotid stenting has the potential to be a safe and effective method of restoring blood-flow to the brain. However, doubts persist over the safety of the procedure. This project involves designing and developing a new device to remove fragments of atherosclerotic plaque from an area that has been stented with a self expandable stent. The project involves a number of steps: 1. Designing a new transcatheter device 2. Developing and manufacturing the prototype 3. Evaluating the efficacy of a prototype in an experimental set-up.
Pre-requisites	4B15, 4B16, strong design skills, and the student must contact me prior to the summer break to ensure that the administrative tasks are put in place in a timely manner (e.g. submission of ethics approval forms)
Is it suitable for a BSc student (YES/NO)	Yes

Title	The forgotten blood vessel – The Vein
Supervisor Name and Code	Bruce Murphy (BM4)
Description	Venous disease is common; however it is seldom life threatening in comparison to arterial disease therefore it has received little attention in the scientific literature. However, as new technologies are developed to treat venous disease the mechanical properties of this tissue must be fully understood. This project involves determining the tensile properties of venous tissue, initially determining the static tensile strength and subsequently determining the creep properties of the tissue.
Pre-requisites	4B15, 4B16
Is it suitable for a BSc student (YES/NO)	No

Title	Quantification of valve leaflet damage induced by transcatheter valve repair devices
Supervisor Name and Code	Bruce Murphy (BM5)
Description	New transcatheter devices are in development that will allow clinicians to treat mitral valve disease without the patient undergoing open-heart surgery. One of the unknown aspects of these new treatments is how the devices interact with the native mitral leaflets. This study involves quantifying the

	damage induced by the new devices. The student will develop a number of new experimental protocols, e.g. new mechanical tests and damage quantification methods. The goal of this study is to optimize the material and design aspects of a mitral valve repair device to minimize damage to the valve leaflets.
Pre-requisites	4B15, 4B16
Is it suitable for a BSc student (YES/NO)	No

Title	Development of a protocol to harvest bovine/porcine tissue for use in a new transcatheter mitral valve repair device
Supervisor Name and Code	Bruce Murphy (BM6)
Description	Bovine and porcine tissue has been shown to be an excellent biomaterial for use as the valve leaflet component in surgically implanted heart valve prostheses. However transcatheter devices require the tissue to have additional properties to the surgical devices. In this study the student will examine the feasibility of utilizing porcine/bovine tissue within a transcatheter mitral valve repair device. The results will be used to recommend the optimal manufacturing protocol for developing valve components within a new device.
Pre-requisites	4B15, 4B16
Is it suitable for a BSc student (YES/NO)	No.

Title	Efficient electric cookstove for developing urban centers
Supervisor Name and Code	Tony Robinson (TR1)
Description	Cooking daily meals in many urban centers in developing countries is facilitated by burning fossil fuels or wood based biomass, even though the dwellings may be grid connected. The rising cost of fossil fuels and biomass, combined with obvious environmental and health and safety issues, has some development agencies considering the possibility of electric cookstoves as a cost effective alternative to traditional fire based cooking. This project will involve the design, development and characterization of an ultra efficient and ultra low cost electric cookstove for meal preparation in urban grid-connected dwellings in the developing countries.
Pre-requisites	Enrolled in SS Heat Transfer & SS Thermodynamics
Is it suitable for a BSc student (YES/NO)	No

Title	Energy scavenging for off-grid electrification in the developing

	world
Supervisor Name and Code	Tony Robinson (TR2)
Description	The electrical energy requirement in developing countries is hugely lower than what is demanded in developed countries. For basic things such as lighting and mobile phone charging, in the range of 0.2W-1W per person would suffice compared with the average of 5 kW per person in Ireland, for example. This project will involve performing a detailed survey of low grade energy sources and energy conversion technologies that are accessible to people in remote off-grid regions in developing countries. Selected demonstrators will be built, tested and compared against conventional photovoltaic systems with regard to cost, performance, reliability, robustness, functionality and appropriateness in the context of the end device requirement and the socio-economic climate within which the technologies will be deployed.
Pre-requisites	None
Is it suitable for a BSc student (YES/NO)	Yes

Title	Low cost Stirling Engine
Supervisor Name and Code	Tony Robinson (TR3)
Description	Sterling engines have been receiving a lot of attention recently due their high thermal efficiency, relative simplicity and wide operating range. In particular, they offer the possibility for energy scavenging from a variety of waste heat sources. This project will involve the development of a simple, robust and inexpensive Sterling engine for off-grid electrical power generation for use in developing countries. Heat sources including, but not limited to, solar thermal and waste heat from biomass combustion will be explored for potential exploitation.
Pre-requisites	Enrolled in SS Heat Transfer & SS Thermodynamics
Is it suitable for a BSc student (YES/NO)	No

Title	Efficient central heating
Supervisor Name and Code	Tony Robinson (TR4)
Description	Radiators used for conventional domestic heating have not advanced technically for the past 150 years or so. This being the case, there is an obvious space for innovative technologies to be developed which can improve energy efficiency of hydronic central heating systems with associated cost savings and CO2 reductions. In particular, using lower grade/temperature geothermal energy sources and smart

	monitoring and control of otherwise passive radiators offers the opportunity for development of low cost energy efficient retrofit technologies that may result in a faster return on investment compared with other retrofit solutions. This project will involve the full characterization of a broad range of central heating radiators with performance metrics which generally have not been considered in the past; including but not limited to heat throughput for varying inlet parameters, transient response, cost and acoustic emissions (in the case of fan assisted units). Coupled with this will be the development of low cost sensing and monitoring technology that can be used with appropriate adaptive control technology.
Pre-requisites	Enrolled in SS Heat Transfer & SS Thermodynamics
Is it suitable for a BSc student (YES/NO)	No

Title	Thermal modelling of refrigeration systems
Supervisor Name and Code	Tony Robinson (TR5)
Description	The overall coefficient of performance of domestic refrigerators and freezers is hugely influenced by the control strategy used for operating the compressor. Innovative control solutions for refrigeration systems require that the static and dynamic thermal response characteristics of the refrigerator under varying load conditions be known a priori. The lack of a comprehensive thermal model of the refrigerator system is thus a severe bottleneck hampering the development of innovative strategies to reduce the energy consumption of domestic refrigeration systems. This project will experimentally characterize a commercially available refrigeration unit and develop the thermal model(s) required for a parallel project which will develop the control hardware and software to improve refrigerator performance.
Pre-requisites	Enrolled in SS Heat Transfer & SS Thermodynamics
Is it suitable for a BSc student (YES/NO)	No

Title	Thermal characterization of thin thermal barrier coatings
Supervisor Name and Code	Tony Robinson (TR9)
Description	Thin thermal barrier coatings are an important technology in space applications where there are severe size and weight constraints. Also, nanotechnologies are currently being

	developed which provide thin thermal barriers by blocking the flow of phonons while at the same time allowing electrons to flow. In effect, the nanostructured surface coating results in a unit with high electrical conductivity and low thermal conductivity compared with the bulk material upon which the coating exists. These engineered device characteristic have enormous potential for high performance thermoelectric conversion technologies. One problem, however, is that due to the small scales, conventional techniques for thermal conductivity measurement cannot be used and at present, must rely on very expensive and technically sophisticated methods which in turn impede the progress of this branch of material science. This project will involve the development of a new experimental technique for measuring the effective thermal resistance of thin thermal barrier coatings.
Pre-requisites	Enrolled in SS Heat Transfer
Is it suitable for a BSc student (YES/NO)	No

Title	Harnessing power sources for off grid applications
Supervisor Name and Code	Dermot Geraghty (DG1)
Description	Photovoltaic technology is too expensive to entertain mass deployment in remote developing regions which have no access to the grid. However, there are alternative and unconventional energy sources that can provide the base load electrical requirement for simple things such as lighting with high efficiency LEDs and mobile phone charging. However, the energy density and electrical output characteristics of these sources are typically not suited for direct replacement of batteries and thus require specialized conditioning and/or some means of storage, such as rechargeable batteries. This project will develop cost-constrained and innovative technologies appropriate for enabling unconventional energy sources to be used for low power devices in off- grid and remote developing regions
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes

Title	Adaptive control of domestic heating systems
Supervisor Name and Code	Dermot Geraghty (DG2)

Description	It is well known that active control of domestic heating can improve the overall efficiency and comfort associated central heating systems. The enormous cost reduction in microelectronics and wireless high technology in the past decade is one reason why it is possibly cost effective to integrate smart sensing and adaptive control into low technology (and low cost) central heating systems with associated cost, comfort and environmental benefits. This project will involve the development of innovative and cost constrained sensing and control hardware and software for improving the energy efficiency of domestic central heating systems.
Pre-requisites	3B6, 4B9, SS Heat Transfer
Is it suitable for a BSc student (YES/NO)	No

Title	Further development of an Air quality monitoring system
Supervisor Name and Code	Dermot Geraghty (DG3)
Description	A low cost system for long term air quality monitoring is under development in the department. This project will continue development of the gas sensor stage of the system. The objective is to complete the design and integrate the sensors with an existing data acquisition system which will be deployed at a test site and evaluated as a long term pollution monitoring device. Examples of gases which will be used monitored are CO, CO2, NO, NO2. This project will use commercially available sensors which will be packaged as complete gas sensors and tested in the field against reference devices. Real time air quality information will be provided on the internet
Pre-requisites	Willingness to learn some electronic construction techniques
Is it suitable for a BSc student (YES/NO)	No

Title	Adaptive On/Off control of temperature in domestic refrigeration systems
Supervisor Name and Code	Dermot Geraghty (DG4)
Description	Relay based control is used to control the temperature of foodstuffs in domestic freezers. The quality of the food and the efficiency of the power pack can be improved using adaptive control algorithms. However, it must be possible to implement these algorithms using the low end sensors and actuators

	typically found in domestic freezers. The objective of this project is develop and implement a suitable control algorithm. The refrigeration system will be modeled in project TR5. This project started in 2010-11 with work on simulation of adaptive on/off control using describing function theory.
Pre-requisites	Must have done 3B6, recommend 4B9, Highly mathematical project
Is it suitable for a BSc student (YES/NO)	No

Title	Humidity Measurement Technology
Supervisor Name and Code	Dermot Geraghty (DG5)
Description	This project will investigate methods for humidity measurement and establish the state of the art from a review of the literature and from an evaluation of commercially available products. The project will aim to identify all techniques currently used in humidity measurement and determine which of them have been incorporated into commercially available instruments. The project will evaluate a number of sensors from the points of view of performance, cost, robustness and reliability and identify at least one as a candidate for the development of a humidity sensor. This project is a 'new product development' style project.
Pre-requisites	3B6
Is it suitable for a BSc student (YES/NO)	Yes

Title	Evaluation of a system for embedded strain measurement on HGVs
Supervisor Name and Code	Dermot Geraghty (DG6)
Description	A new instrument for measuring strain in truck axles has been designed and manufactured. However, no performance data is available for it yet. This project will focus on testing the performance of the instrument in measuring the strain in HGV axles. Some embedded software will have to be developed and the student will have to develop an understanding of the electronics of typical strain measurement devices. The target end application for the instrument is in load estimation from measurements of axle strain.
Pre-requisites	Interest in electronics and measurement

Is it suitable for a BSc student (YES/NO)	No

Title	Energy efficient domestic buildings- a platform for quantifying the thermal performance of a domestic building.
Supervisor Name and Code	G.O'Donnell (GOD1)
Description	Energy efficient technologies are widespread and easily available and implemented in domestic dwellings. The Irish Government has incentivized the market by facilitating grants through bodies such as Sustainable Energy Authority of Ireland. In response, there is a plethora of technologies, ranging from simple insulations solutions, complex boiler upgrades, sophisticated geothermal and solar thermal heating solutions and many others. However despite these widely available technologies, it is generally accepted that both the energy impact and financial impact of the energy upgrades is difficult to quantify. This project will attempt to address this issue by focusing on the quantification of the thermal performance of a domestic building. The project will involve the development of a comprehensive data acquisition and control system that will record the energy performance of the domestic dwelling, including inputs such as boiler feed and return temperature, weather station data, building fabric performance, room temperatures and humidity. Interest in the area of energy efficiency as well as interest and some knowledge of LabView software is a distinct advantage.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes.

Title	Energy efficiency in compressed air systems for pneumatic automation
Supervisor Name and Code	G.O'Donnell (GOD2)
Description	Automation is the cornerstone of high tech manufacturing processes. Pneumatics and electro-pneumatics are some of the main methods for automated assembly and handing of parts in sectors such as automotive, medical devices and consumer goods. Given the extensive use of pneumatics, there is scope to investigate the energy efficiency of these systems in order to identify and implement a reduction in the use of compressed air. In assessing the performance (cycle time or energy consumption) of a pneumatic drive the flow capability of the circuit is of critical importance. Traditional flow methods for the characterisation of pneumatic components are practically difficult to implement in the industrial context. Inverse methods, for the characterisation of circuits, look promising but face difficulties for high conductance circuits and/or small volume supply. This project aims to assess the feasibility of

	inverse methods for industrial environments and involves the experimental/modelling analysis of pneumatic circuits. Matlab familiarity and interest in fluid power would be useful. The project will use existing test benches and existing rigs in order to undertake the experimental investigations.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes.

Title	Design, development and testing of an inspection system for abrasive processes
Supervisor Name and Code	G.O'Donnell (GOD3)
Description	The Manufacturing Research group has been developing a novel system for the inspection of abrasive surfaces, such as the quantification of wear on abrasive surfaces such as grinding wheels. The system has evolved from desk top, to a lab based system, and the next evolution is towards industrialization. The project will involve further testing of the current system to understand the limitations of its performance, and the redesign and development of the next version of the system. As this project is focusing on industrializing the system, a survey of the market, as well as the route to market will be necessary. The technical work will require hands on skills in experimental work, and skills using ProE or Solidworks.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes.

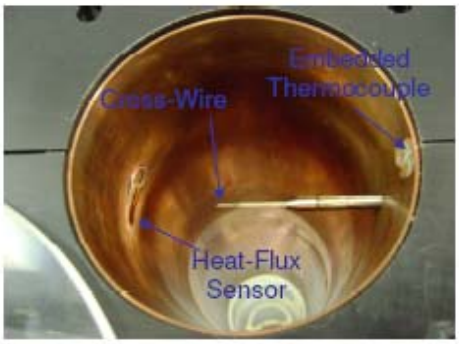
Title	The development of the ultrasonic impact grinding process
Supervisor Name and Code	G.O'Donnell (GOD4)
Description	Micro ultrasonic impact grinding is a micro material removal process suitable for niche application such as the machining of brittle materials, e.g. ceramics, glass, silicon. A newly developed micro ultrasonic impact grinding machine has been developed in the Manufacturing Research group. The project will focus on the testing and evaluation of the currently developed system in the machining of materials such as Tungsten Carbide, and Ceramics. Following initial evaluation of the current system, the project work will involved the design of a next generation Ultrasonic Impact Grinding machine. Hands on skills in experimental work will be a distinct advantage in this project together with skills using ProE or Solidworks for the design part of the project. The project may also consider the development of control

	algorithms such as force control feedback.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes.

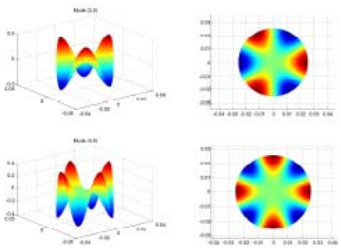
Title	The development of control algorithms for workpiece scanning system
Supervisor Name and Code	G.O'Donnell (GOD5)
Description	A novel workpiece scanning system integrating multiaxis motion control, and laser measurement has been developed in the Manufacturing Research group. The project will focus of further design of the system, including the integration of a confocal measurement head. The project will require the development of the control algorithms using LabView software which will control motion, configure measurement devices and record and analyse the data. This challenging project is particularly suited to someone interested in control engineering, with interest and experience in using LabView.
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes.

Title	
Supervisor Name and Code	G.O'Donnell (GOD6)
Description	
Pre-requisites	
Is it suitable for a BSc student (YES/NO)	Yes.

Title	Heat Transfer Enhancement Due to Acoustic Excitation….continued
Supervisor Name and Code	G. Bennett (GB1)
Description	This project will study the improvement in heat transfer that can be attained when the flow velocity field due to forced convection is modified with a particle velocity field created by acoustic excitation. The principal obstacle faced by the computer manufacturing industry in the release of higher performance computers is not the ability to produce faster processors but the inability to cool them. Transistor density on micro-chips is increasing at such a

	rate that the traditional techniques used to cool (remove heat from) them is no longer able to keep up with the heat that they generate. Forced convection is still an important technique but there is an acoustic penalty associated with the cooling fans. If it were possible that the fan noise could be removed downstream of a heat exchanger stage in a duct (see project GB2) then the acoustic sound field or even an increased the acoustic sound field (a louder fan!) could be used to the benefit of heat transfer. This project will seek to study, measure and optimise the acoustic sound field, and hence heat transfer, in a duct where heat transfer occurs between the duct wall and the internal air-flow. This project will continue work from previous years. This work is cutting edge research and has already resulted in publication. Needs a lot of dedication and experimental aptitude. Good for those looking to go into research. Not for the faint-hearted!  Figure 5-7 - Plan View of Copper Section
Pre-requisites	Heat Transfer, experimental aptitude. Matlab. Reasonable Mathematics. Ideally Acoustics and Signal Processing. LabView.
Is it suitable for a BSc student (YES/NO)	No

Title	Acoustic characterisation of axial fans-Modal Decomposition
Supervisor Name and Code	G. Bennett (GB2)
Description	The principal obstacle faced by the computer manufacturing industry in the release of higher performance computers is not the ability to produce faster processors but the inability to cool them. Transistor density on micro-chips is increasing at such a rate that the traditional techniques used to cool (remove heat from) them is no longer able to keep up with the heat that they generate. Forced convection is still an important technique but there is an acoustic penalty for an increase in flow velocity. An effective means to reduce the noise created by the fan

	would facilitate increased heat transfer. Two previous projects have designed and built a rig to examine the acoustic output and pressure performance of axial fans and also the effect of modifying the fan stator on noise and flow. This next stage will deliberately modify the stator to generate high tonal noise to which an experimental technique will be applied to examine the acoustic field for individual acoustic modes. This work is cutting edge research and has already resulted in publication. Needs a lot of dedication, mathematics and experimental aptitude. Good for those looking to go into research. Not for the faint-hearted!  FIGURE 2.6: Acoustic Mode Shapes; (3, 0) and (4, 0)  FIGURE 7.10: A close-up of one of the tube sections used for modal decomposition. The microphones can be seen to be flush mounted with the inside surface.
Pre-requisites	Pre-requisites Experimental Aptitude. Matlab., Good Mathematics. Previous training in acoustics and fluid mechanics, Pro-E/Solid Works an advantage. Signal Processing experience/aptitude.
Is it suitable for a BSc student (YES/NO)	No

Title	Design of a forced convection clothes drier
Supervisor Name and Code	G. Bennett (GB3)
Description	Tumble driers are expensive to run, the weather is inclement and apartments and houses would be better without rooms full of drying clothes on clothes horses. A solar powered clothes drier which would fit on the balcony of an apartment is a business opportunity. The project would involve modeling the drying process and the design of the solution using axial fans. The project would follow on from a

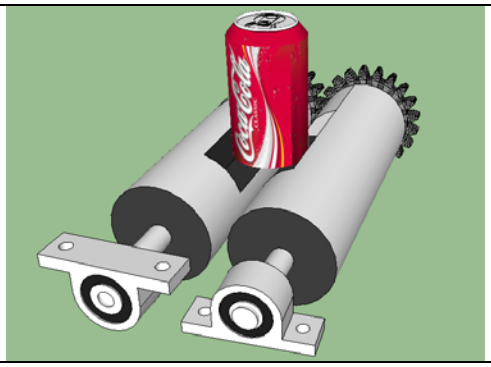
	previous years work.
Pre-requisites	Pre-requisites Experimental Aptitude. Reasonable Mathematics. Fluid mechanics. An interest in design
Is it suitable for a BSc student (YES/NO)	Yes.

Title	GreenTractor
Supervisor Name and Code	G. Bennett (GB4)
Description	Agricultural tractors are the workhorses of the modern farm. In pursuit of efficiency, consolidation has resulted in extremely large farms with proportionately large equipment. This has resulted in very high power and expensive vehicles being the norm on offer. There are still a large number of small farms in the world with Ireland having a relatively high proportion. As a result, the power-needs of this market are significantly lower. In addition, there is a large amount of renewable energy available with much more due to come on line in the near future. You are asked to design a low power (torque) electric tractor. It is specified that renewable energy would be used to power the vehicle. It is foreseen that wind power would be used to charge vehicle mounted batteries.
Pre-requisites	Interest in design. Practical approach to engineering, design and manufacture. Must have completed the 3B8 GreenTractor project.
Is it suitable for a BSc student (YES/NO)	No

Title	Design of Novel Bike Lock/Stand continued
Supervisor Name and Code	G. Bennett (GB5)
Description	Cycling is currently on the increase in Dublin again since the removal of heavy goods vehicles from the inner city. As a result there is a need for additional parking facilities for bicycles and an opportunity for a novel, innovative bike storage solution. A previous project has successfully designed a novel bicycle lock an stand using systematic design techniques see below

	 This project twill further develop the design to allow it to be used with Sheffield hoops and a suitably aesthetic stand designed.
Pre-requisites	Pre-requisites Interest in design and cycling. Practical approach to engineering, design and manufacture. Pro-E/Pro-Mechanica/Solid Works.
Is it suitable for a BSc student (YES/NO)	Yes

Title	SolarCrush
Supervisor Name and Code	G. Bennett (GB6)
Description	Renewable energy, efficiency, recycling and innovation are all current in today's parlance, as they are relevant to this project which seeks to combine the successes of the Big Belly (http://www.bigbellysolar.com/) with a manual drinks can crusher to be seen outside the Pavilion Bar. A previous project has successfully designed a solution using systematic design techniques which resulted in a workable design which uses a solar panel to power a can crusher. This project will further the design to improve functionality, instrumentation and will provide for an enclosure. An investigation in certification will also be performed.

	
Pre-requisites	Interest in design. Practical approach to engineering, design and manufacture. Pro-E and Pro-Mechanica.
Is it suitable for a BSc student (YES/NO)	Yes

Title	Heat Engine Design
Supervisor Name and Code	Henry Rice (HR1)
Description	This project is a development of the thermoacoustic engine worked on this year with effectively converts a thermal gradient into acoustic energy. This project will see the introduction of a piston into a bench top rig to devise a machine which might be considered as a classic stirling engine with only one moving part. Spectacular attempts to implement these are available on Youtube but this project would be expected to do better.
Pre-requisites	Thermodynamics, Vibration, Design interest
Is it suitable for a BSc student (YES/NO)	Yes

Title	Noise Vehicle Harshness Study
Supervisor Name and Code	Henry Rice (HR2)
Description	This project will investigate the refitting of a simple vehicle with sound insulation materials. Although stock treatments will probably be used in the end, Before and after measurements and acoustic modeling of the vehicle interior will be performed with proposals for treatment
Pre-requisites	Acoustics, Vibration
Is it suitable for a BSc student (YES/NO)	Yes

Title	Directionality in Environmental Noise
Supervisor Name and Code	Henry Rice (HR3)
Description	The project will involve measurement and predictive modeling of some of the local streets focusing on directionality in the

	sound field. This will require the use and calibration of a tetra mic and will ultimately explore the concept of directionality as an annoyance factor in environmental noise
Pre-requisites	Programming, Acoustics
Is it suitable for a BSc student (YES/NO)	Yes

Title	Further Development of a multidirectional loudspeaker system
Supervisor Name and Code	Henry Rice (HR4)
Description	Speakers where the directionality of the test signal are now finding use in the detailed calibration of listening/performing spaces where perception of depth is important. Last year an amplification system was implemented for the multidirectional speaker system developed in the department the previous year. Some further work needs to be done on the electrics for this system and comprehensive test program including laser measurements of the individual diaphram motion will be done. The generation of some novelty sound fields will also be attempted using the new system.
Pre-requisites	Acoustcs, mechatronics, some programming
Is it suitable for a BSc student (YES/NO)	Yes

Title	Vibro-Acoustics of composite panels
Supervisor Name and Code	Henry Rice (HR5)
Description	The replacement of conventional panels in cars in particular with panels wmade with carbon fibre structure offer huge potential for weight/energy saving without compromising interior acoustics. The emergence of the electric car will also require the introduction of thermal layers as there is no method of heating an electric car as it runs at speed. The project will involve measurement and /or modeling of a test structure which will be developed in the department over the next few months.
Pre-requisites	Vibration, Acoustics, Materials, Thermodynamics
Is it suitable for a BSc student (YES/NO)	Yes