Erasmus+ Research Internships Engineering:

Materials and Surface Engineering; Automotive Systems Engineering; Mechanical and Energy Systems Engineering

1- **Project Title: Automotive Engineering - Brake Noise Vibration & Harshness (NVH) Experiments & Analysis**

2- **Project Title: Multi-vector Energy Systems Planning and Operation with High Penetration of Renewable Energy Sources**

3- **Project Title: Energy Management of Hybrid AC/DC Microgrids**

4- **Project Title: In Situ surface hardening of Ti-6Al-4V coated with Ni/Al2O3 nano-crystalline coating using TIG welding**

5- **Project Title: Corrosion performance of Zn coated EN24 steel in the presence of nitric acid**

6- **Project Title: Dissimilar joining of Al2O3 to magnesium AZ31.**

7- **Project Title: Performance characterization of spin coated nano-reinforce coatings containing TiO2 or graphene oxide**

8- **Project Title: Control of Mechanical and Physical Properties of Seeded Granules and Tablets**

9- **Project Title: Control of Mechanical and Physical Properties of Seeded Granules and Tablets**

1- Project Title: Automotive Engineering - Brake Noise Vibration & Harshness (NVH) Experiments & Analysis

Project outline

The Braking Research Centre at the University of Bradford has a strong track record of research collaboration with the automotive industry in the field of brakes and braking systems. Working within the Braking Research Laboratory at the University, you will use advanced experimental techniques to analyse source and response mechanisms relating to automotive brake noise vibration and harshness. The work will involve the analysis of frictional and thermal instabilities leading to refinement issues such as low frequency brake judder, semi-resonant creep-groan and high frequency squeal. This advanced research work will focus on systems and brake hardware relating to automotive industry partners and will involve experimental techniques such as whole-body visual displacement, thermal imaging, experimental modal analysis and operational deflection shape identification.

Activities involved

- Review of relevant literature
- Training on equipment relating to the field of study
- Instrumentation, testing & data acquisition
- Data analysis
- Simulation (e.g. FEA/MBS/CFD)

Deliverables

- Weekly progress reports on experimental activities.
- Final technical report & documentation

Prerequisites

- Suitable candidates will be studying for a degree in Mechanical Engineering, or a related subject area.
- Familiarity with CAD, data logging and MATLAB is beneficial, but not essential.

Level: Undergraduate and Postgraduate

Places available: 2

2- Project Title: Multi-vector Energy Systems Planning and Operation with High Penetration of Renewable Energy Sources

The electrification of heat along with a large utilisation of renewable sources for power generation are considered as a solution to meet the emission and renewable targets for UK. However, these will result in variability and uncertainty in electricity supply as well as substantially higher peaks of electricity demand. If these issues are to be addressed through a "predict and provide" approach (i.e. building more capacity for back-up power generation, transmission and distribution infrastructure), significantly high costs will be incurred. These costs can be reduced by employing flexibility technologies enabling peak shaving and supporting electricity demand and supply balancing.

This project will investigate the role of battery storage and power-to-gas systems to accommodate large capacity of intermittent power generation from wind and solar and therefore facilitates matching electricity supply and demand. The Combined Gas and Electricity Networks (CGEN) model will be used to optimize the operation and planning of gas and electricity networks in Great Britain. Using a CGEN expansion model, the impact of demand side response (DSR) on the electricity and gas supply systems in GB will also be investigated in this project.

Prerequisites:
Suitable candidates will be studying for a degree in Electrical Power Systems, or a related subject area.

Level: Undergraduate and Postgraduate

Places available: 2

3- **Project Title: Energy Management of Hybrid AC/DC Microgrids**

Microgrids are small, self-controlled systems embedding distributed energy resources and loads, which can be operated in either grid-connected or islanded mode. Existing microgrids often adopt AC systems, but the growing penetration of DC loads, DC-based renewable energy sources and DC-based energy storage has recently drawn interest in DC microgrids. In this situation, hybrid AC/DC microgrids -aggregating distributed energy resources and loads into distinct AC and DC sub- microgrids, tied together by bidirectional interlinking converters – represent a more likely architecture. Hybrid microgrids can be a cost-effective solution to supply affordable and reliable electricity to rural and remote communities, given their unique feature of using locally available generation resources (such as solar, wind, water stream and biomass) to supply the specific demand needs.

The aim of this project is to introduce hybrid AC–DC Microgrids in the future distribution networks to utilise both benefits of alternative and direct currents. An operational framework is proposed to minimise the operational cost by receiving maximum power from renewable distributed resources, minimising power transfer between AC and DC links, and controlling the voltage variation of both AC and DC sub-grids.

Prerequisites: Suitable candidates will be studying for a degree in Electrical Power Systems, or a related subject area.

Level: Undergraduate and Postgraduate

Places available: 2

4- Project Title: In Situ surface hardening of Ti-6Al-4V coated with Ni/Al2O3 nano-crystalline coating using TIG welding

Description

The Ti-6Al-4V alloy is the most important and widely used titanium alloy which enjoys the welding, forging and machining capabilities and find extensive application in biomedical engineering, automotive, aerospace and military applications. Given that the alloy has the capability of being heat treated in order to reach a maximum strength of up to 165 ksi. But, one of its disadvantages is low hardenability.

This study will explore the potential of increasing the surface hardness of Ti-6Al-4V using a novel two-step process. The Ti-6Al-4V samples will be coated using an electrodeposited nanostructure coating followed by surface hardening using TIG welding. Each sample will be investigated using an optical microscope, Scanning electron microscopy, X-ray diffraction and wear testing.

Table 1: parameters to be studied

Parameters	Levels settings		
Particle concentration	Ni/Al2O3 (20 g/l) 40nm	Ni/Al2O3 +TiO2 (15 and 5 g/l) 40nm	Ni/Al2O3 +TiO2 (10 and 10 g/l) 40nm
Current Density (A/dm2)	3	5	8
Welding current (A)	50	75	100

The main objectives of this study are:

- To study the effect of coating parameters; current density, particle size and concentration on the hardenability of the Ti-6Al-4V surface.
- Evaluate the effect of welding current on the hardenability of the Ti-6Al-4V surface.

Prerequisites: Materials and Surface Engineering**;** Automotive Systems Engineering; Mechanical and Energy Systems Engineering previous knowledge at Undergraduate or Postgraduate levels.

Level: Undergraduate and Postgraduate

Places available: 2

5- Project Title: Corrosion performance of Zn coated EN24 steel in the presence of nitric acid

Description

Coal tar epoxy coatings are described as a heavy-duty anti-corrosive protective coating for engineered materials. The objective of this study is to investigate the ability of coal tar epoxy coating to provide anti-corrosion protection for brass pipes in the presence of nitric acid. The permeability of the coatings to the solution will be monitored by potential, current and solution ph. The surface analysis of brass pipes will be studied by SEM and energy dispersive X-ray (EDX) techniques.

The main objectives of this study are:

- Developing epoxy coatings by spin coating
- Evaluate the corrosion behaviour of the coated and uncoated steel.
- Characterise the corroded surfaces using techniques such as, TGA, SEM and XRD
- Evaluate the optical properties of the coatings deposited.

Prerequisites: Materials and Surface Engineering**;** Automotive Systems Engineering; Mechanical and Energy Systems Engineering previous knowledge at Undergraduate or Postgraduate levels.

Level: Undergraduate and Postgraduate

Places available: 2

6- Project Title: Dissimilar joining of Al2O3 to magnesium AZ31.

Description

The application of ceramic in several branches of engineering has increased significantly over the last two decades. To obtain optimum performance of engineering systems, it is often important to combine dissimilar materials to produce hybrid systems with combined properties. The challenge, however, is identifying suitable technology for joining ceramics to metals or polymers, etc. The intrinsic properties of most ceramics virtually rule out all methods of fusion welding. However, solid-state techniques, adhesive bonding, and brazing all remain as possible means of providing strong, sound joints between ceramics and metals. The objective of this study is to assess the potential of diffusion bonding alumina to magnesium and to evaluate the effect of the bonding parameters on the quality of the bond.

The main objectives of this study are:

- Optimise the bonding parameters to maximise the strength of the joint produced
- Determine the variation of hardness across the bond interface
- Characterise the bonded joint using techniques such as, SEM, EDS and XRD

Prerequisites: Materials and Surface Engineering**;** Automotive Systems Engineering; Mechanical and Energy Systems Engineering previous knowledge at Undergraduate or Postgraduate levels.

Level: Undergraduate and Postgraduate

Places available: 2

7- Project Title: Performance characterization of spin coated nano-reinforce coatings containing TiO2 or graphene oxide

Description

The nano-scale studies in the literature have revealed the excellent anti-friction properties of graphene and its great potential as a nano solid lubricant. However, for macro-scale applications the integrity and durability are main problems for most graphene-based surface coatings. This compound has attracted substantial attention in especially photovoltaic field. Graphene has several properties that make them desirable for various engineering application. These properties include; excellent thermal and structural stability, high specific stiffness and strength, high heat capacity and good thermal conductivity. One way to mediate the durability issue while exploiting the mechanical properties of graphene is graphene-based composites. The objective of this study is to synthesize and characterize thin films containing graphene oxide (GO) combined and TiO2 nanoparticles composite coatings fabricated by spin coating technology.

The main objectives of this study are:

- Evaluate the tribological properties of the coatings by wear testing.
- Determine the thermal properties (density, specific heat and thermal conductivity) of the material.
- Characterise the oxidation behaviour material using techniques such as; SEM, EDS and XRD
- Evaluate the properties of the coatings deposited.

Prerequisites: Materials and Surface Engineering**;** Automotive Systems Engineering; Mechanical and Energy Systems Engineering previous knowledge at Undergraduate or Postgraduate levels.

Level: Undergraduate and Postgraduate

Places available: 2

8- Project Title: Control of Mechanical and Physical Properties of Seeded Granules and Tablets

In this study one of the greatest challenges for modern day particle engineering, control of particle properties, is tackled. Here, the process of focus is granulation, otherwise known as size enlargement of solid particulates. Granulation is normally employed in various process industries like food and pharma to improve the processes ability or mechanical properties of fine powders i.e. flowability, wettability, compactibility, compressibility, etcetera. Seeded granulation is a special variant of granulation where the internal microstructure is consistently a coarse particle surrounded by fine particles. Following on from previous studies and consultation with several pharmaceutical companies, it has been determined that seeded granules may exhibit superior properties when compared to classical granules. This also includes their effect on tablets produced downstream. This project will involve controlling mechanical and physical properties of seeded granules in order to cater to different applications. The properties of concern are: porosity, friability, strength and dissolution and flowability.

Prerequisites: Materials and Surface Engineering**;** Automotive Systems Engineering; Mechanical and Energy Systems Engineering previous knowledge at Undergraduate or Postgraduate levels.

Level: Undergraduate and Postgraduate

Places available: 2

9- Project Title: Control of Mechanical and Physical Properties of Seeded Granules and Tablets

The major greenhouse gases (GHG) (over 80%) is carbon dioxide (CO2) which is produced mostly due to burning of fossil fuels. GHG has changed the climate as it traps heat and make the planet warmer and consequently increasing sea water level. The reduction of GHG emissions is agreed in November 2016 in the Paris international agreement to an annual average of 160 million tonnes (IEA Dec. 2016). This agreement is expected to create a transformative change in the energy sector to combat climate change. This project is aimed to discover techno-economic feasibility of carbon capture process such post-combustion carbon capture, oxy-fuel and pre-combustion carbon capture etc. Influence of Carbon Capture and Storage (CCS) on the UK and the global economy are investigated. The aim of this project is to look into the impact of CCS on macro-economic factors such un-employment, GDP, export, imports, etc. The final goal is to find an economical trend, empirical or mathematical model, as a function of captured CO2.

Prerequisites: Materials and Surface Engineering**;** Automotive Systems Engineering; Mechanical and Energy Systems Engineering previous knowledge at Undergraduate or Postgraduate levels.

Level: Undergraduate and Postgraduate

Places available: 2