Faculty of Engineering
University of Malta
Msida MSD 2080

um.edu.mt/eng
+356 2340 2440
engineering@um.edu.mt

Faculty of Engineering Projects

2023

60 YEARS
OF ENGINEERING
IN MALTA

L-Università ta' Malta
Faculty of Engineering

WASTESERV

ECOHIVE

fresh perspectives and ideas

a collaborative and inclusive community

circular economy

Join our circle

wsm.com.mt

Ready to become a Futurestarter?

life.augmented

We are creators and makers of semiconductor technologies for a future that we want to make smarter, greener and more sustainable.

Join ST and start the future
#Futurestarters

Foreword

Time flies... This year, 2023, marks the 60th anniversary since the first offering of the engineering degree at the University of Malta, with its first intake of 11 students joining in 1963. The Faculty, its staff, the courses offered, the research involvement as well as our international reputation have come a long way. Nevertheless, our principles and ideologies remain rooted in our origins, anchored to the core belief that students joining the Faculty should receive the best possible education, relevant to current practices and industry, whilst being exposed to a high level of innovation. This is essential, now even more than in 1963, since we continue to face enormous local and global challenges, requiring solutions from well-trained scientists and engineers.

In fact, it is a very good time to be an engineer. The worldwide electrification of transport, drive for sustainability in manufacturing, energy and material use, better understanding and care for the environment, diversification of energy generation and the enhancements in medical aids and tooling are topics that the Faculty is proud to be at the forefront of. The Faculty continues to thrive on collaborative research with business, large and small, at a national and global level and takes pride when such work also leads to tangible impact on a national level. This annual exhibition showcases the work of our undergraduate students, often being congruent to research work previously mentioned, leading graduates to high-value adding job opportunities.

Looking forward, as an educational enterprise the Faculty of Engineering remains committed to maintain its responsiveness to the needs of a changing world, whilst remaining true to its distinctive, original purpose. For this reason, the Faculty continues to seek recognition of its degrees at a European and International level, with 2022/23 marking the accreditation of the B.Eng(Hons) in Electrical and Electronics Engineering with the Institute of Engineering and Technology (IET) and the re-accreditation of the B.Eng(Hons) in Mechanical Engineering with the Institute of Mechanical Engineers (IMechE).

We look forward to welcoming you to the Faculty.

Prof. Inġ. Andrew Sammut
Dean, Faculty of Engineering

#EngineeringTheFuture
#ShineAtUM

Contents

Foreword 1

Contents 2

Courses 3

Projects 6

Section 1 – Biomedical Engineering 6
Section 2 – Electronics Engineering 10
Section 3 – Engineering Mechanics & Structural Integrity 12
Section 4 – Fluid Dynamics & Thermofluids 16
Section 5 – Industrial & Process Engineering 18
Section 6 – Maritime Engineering 22
Section 7 – Materials Engineering 24
Section 8 – Product Development 28
Section 9 – Robotics, Automation & Control 32
Section 10 – Sustainability & Energy Efficiency 36
Section 11 – Transportation 40

Courses

International School for Foundations Studies Course

Certificate MQF Level 4
60 ECTS

Certificate in Foundation Studies in Engineering & ICT

Faculty of Engineering Courses

MATSEC Certificate

Certificate MQF Level 4
60 ECTS

Certificate in Engineering Sciences

Undergraduate MQF Level 6
240 ECTS

ENGINEERS EUROPE

MALTA ENGINEERING PROFESSION BOARD LOCAL WARRANT *

B.Eng.(Hons) Electrical & Electronic Engineering

B.Eng.(Hons) Mechanical Engineering
The course is accredited by the below entities

EUR-ACE®

Engineering Council accredited degree

Institution of MECHANICAL ENGINEERS

THE ROYAL INSTITUTION OF NAVAL ARCHITECTS

Exit after 4 years – Bachelor of Engineering (Honours) (240 ECTS)

Exit after 3 years – Bachelor of Technology (min. of 180 ECTS)

Exit after 2 years – Higher Diploma in General Studies (min. of 120 ECTS)

Exit after 1 year – Diploma in General Studies (min. of 60 ECTS)

Postgraduate MQF Level 7
90 ECTS

Get QUALIFIED

ENDEAVOUR

Funding routes for these postgraduate degrees are available.

by Research

Taught

M.Sc. in Engineering [Various Research Areas]

M.Sc. Integrated Product Development

M.Sc. Building Services Engineering

M.Sc. Maritime Engineering

M.Sc. Signals, Systems & Control

M.Sc. Biomedical Engineering

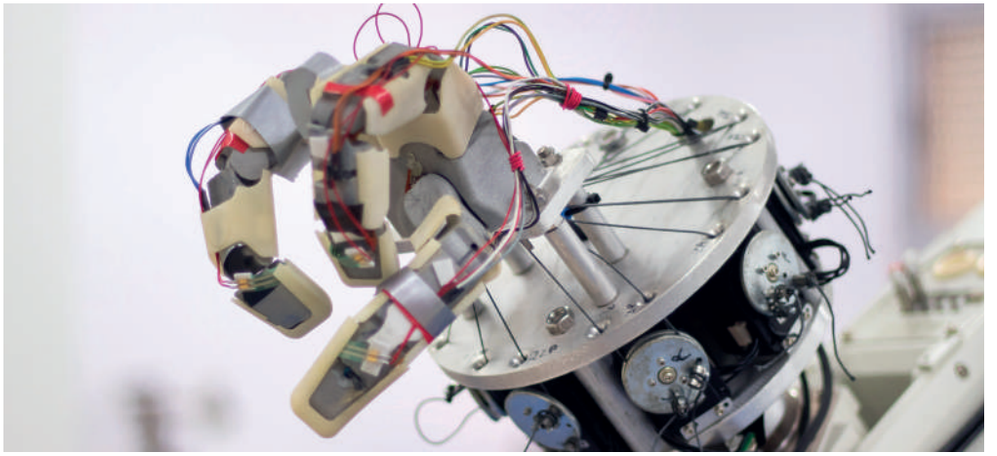
Postgraduate MQF Level 8

Get QUALIFIED

ENDEAVOUR

Ph.D. [Various Research Areas]

* *Through the course one can apply for the engineering warrant and following that the Eur. Ing qualification.*



Bachelor of Engineering (Honours)

MQF Level **6**

Areas of Study

- Electrical and Electronic Engineering
- Mechanical Engineering

Duration

4 Years Full-Time

The Bachelor of Engineering (Honours) course develops the fundamental scientific and mathematical knowledge, engineering design, analysis and practice together with the interdisciplinary economic, ethical and social skills necessary for the different engineering-related job opportunities offered in various local and international industrial sectors such as the aerospace, biomedical, maritime, energy, telecommunications, electronics and manufacturing industries as well as those of building services.

The course focuses on two main universal engineering areas of studies; Electrical and Electronic Engineering and Mechanical Engineering.

The Electrical and Electronic Engineering programme addresses fundamental concepts in electrical engineering, electronics, signal processing and control systems. Students will be able to choose a variety of study-units geared towards the fields of energy generation, conversion, storage and smart distribution, renewable energy, green transportation, electronic sensing, acquisition and measurement, electronic product development, automated systems, autonomous vehicles/robots and software algorithms for signal, image and video processing.

The Mechanical Engineering programme addresses fundamental concepts in mechanical, manufacturing and materials engineering, followed by further focus in one of three streams as selected by the student: Applied Materials in Engineering; or Applied Mechanics and Thermofluids Engineering; or Industrial and Manufacturing Engineering. Students will be able to choose a variety of study-units geared towards fields such as aerospace engineering, automotive engineering, biomaterials, biomechanics, building services, energy, maritime engineering, nanomaterials, polymer and composites manufacturing, quality and reliability engineering, robotics and automation, structural integrity, surface engineering, tool design and manufacture.

This course is recognised by the local Bord tal-Inġiniera as a prerequisite when applying for the Engineering Warrant (Inġ.) and is also internationally recognised by the European Federation of National Engineering Associations (FEANI) when applying for the Eur. Ing. qualification.

The Mechanical Engineering area of study is also accredited by the Institution of Mechanical Engineers (I.Mech.E.) UK and by the Royal Institute of Naval Architects (R.I.N.A.) UK on behalf of the Engineering Council UK as, in part, satisfying the requirements of a Chartered Engineer (CEng - second cycle degree) and fully meeting the requirement of an Incorporated Engineer (IEng). The Mechanical Engineering area of study is also recognised by the European Network for the Accreditation of Engineering Education (ENAEE) and labelled as a first cycle Engineering degree under the EUR-ACE programme.

Entry Requirements

a) *Either* satisfy the General Entry Requirements together with **two** Advanced Level passes at Grade C or better in **Pure Mathematics** *and* **Physics**

or

b) be in possession of the Certificate in Engineering Sciences from the University of Malta.

The Faculty Board may also consider applicants in possession of a qualification at MQF Level 5 in an engineering diploma, together with passes in the Secondary Education Certificate Examination at Grade 5 or better in English Language, Maltese, Mathematics and Physics, to join the course. Such applicants shall be required to present with the qualification they submit for entry, a detailed transcript showing their performance during their studies. They shall further be required to attend for an interview to assess whether they have the necessary aptitude to successfully follow the course.

Certificate in Engineering Sciences

MQF Level **4**

Duration

1 Year Full-Time

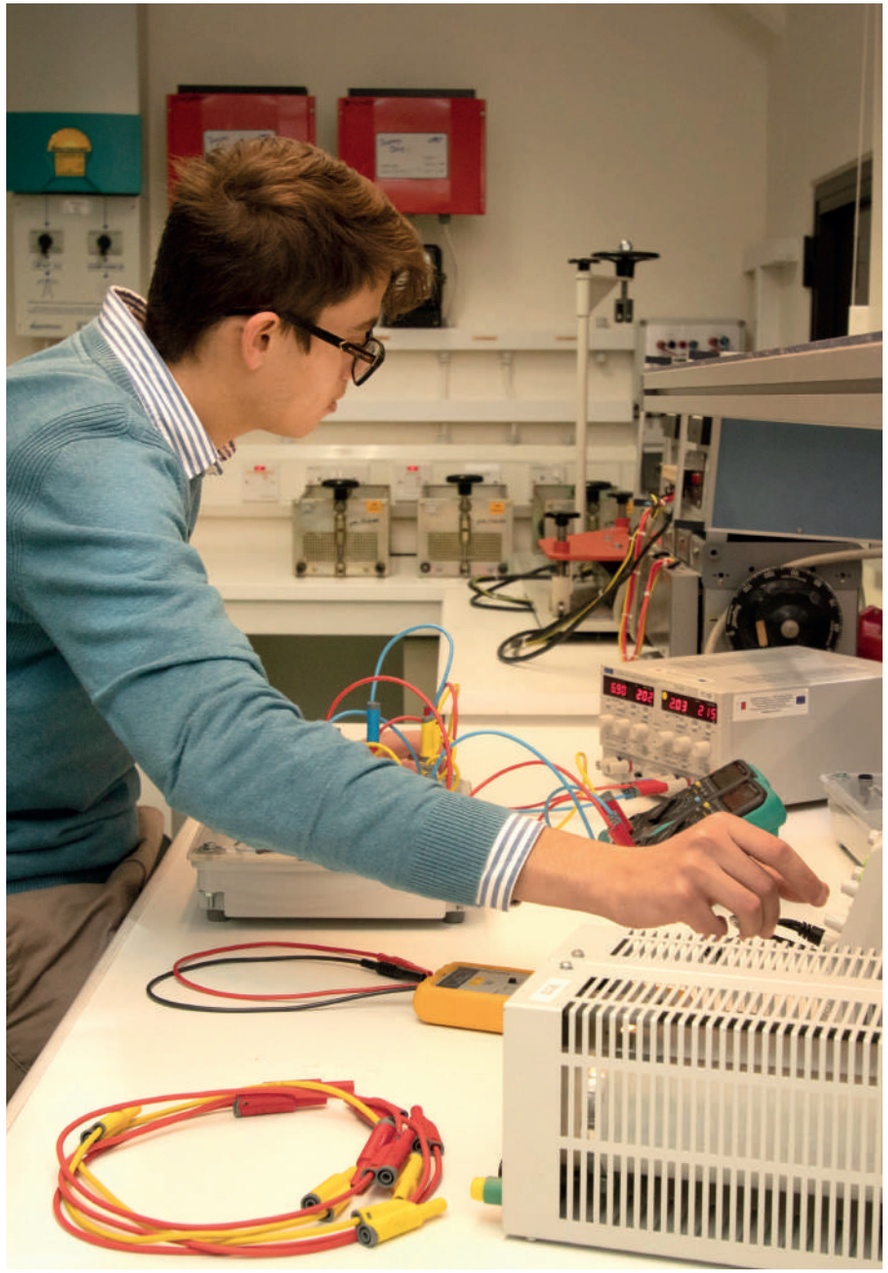
The Certificate in Engineering Sciences is a one-year certificate course intended to prepare students with the knowledge, skills and competencies necessary to follow the B.Eng. (Hons) course. During the course, students will be studying mathematics and physics, bringing the student's knowledge and understanding of these two subjects to the level which meets the specific requirements of the B.Eng. (Hons) degree course. The programme also includes studies specific to the engineering profession. Through engineering workshops and laboratories, the programme will complement theoretical skills with practical skills in mechanical fitting, machining and manufacturing, electrical installations, electronics and control engineering. Moreover, a unit in computer systems and programming will help to prepare the student to become a modern engineer.

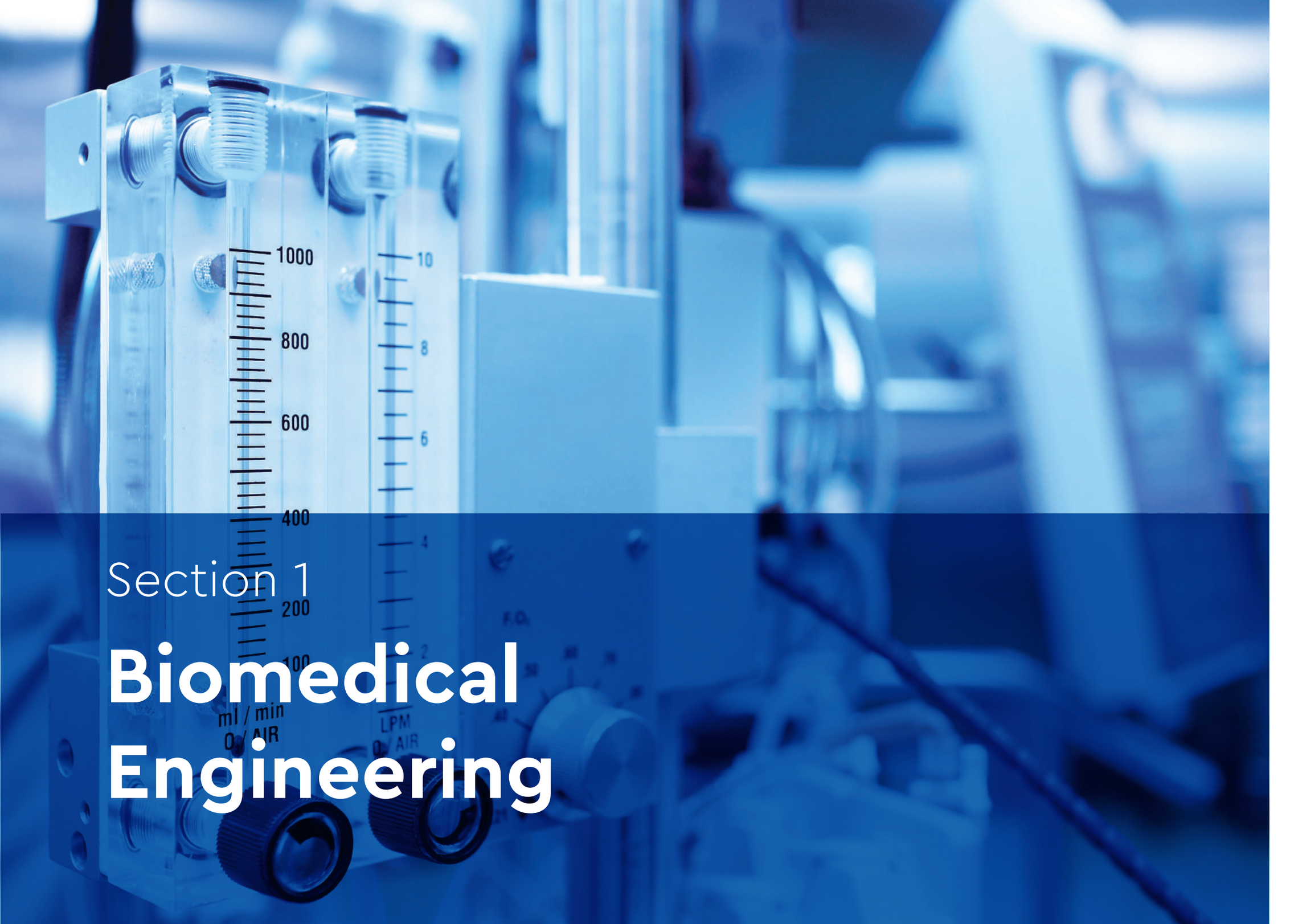
Entry Requirements

General Entry Requirements together with an Advanced Matriculation Level pass in one of the following subjects: **Applied Mathematics, Chemistry, Computing, Engineering Drawing, Graphical Communication, Information Technology, Physics, Pure Mathematics,** or other science/numeric subjects as approved by the Faculty Board.

Applicants in possession of a qualification at MQF Level 4 in an engineering domain obtained with at least Pass with Merit, and of passes in the Secondary Education Certificate Examination at Grade 5 or better in **English Language, Maltese** and **Mathematics** may also apply.

Applicants may be required to attend for an interview to assess whether they have the necessary aptitude to successfully follow the Course.





Section 1

Biomedical Engineering

Biodegradable Zinc for Urological Applications

Student: **Jake Bonello**
Supervisor: **Prof. Inġ. Joseph Buhagiar** | Co-Supervisor: **Prof. Inġ. Bertram Mallia**

What is your project about?

One of the most predominant aspects within the field of medicine that can be improved, is the number of surgeries being conducted. Currently, most procedures involving urinary stents require two operations: one to insert the stent and one to remove it after the designated period. Zinc can be used as a biodegradable material to eliminate the removal surgery. Through the design of a simulation rig, pure zinc wires were tested. The effect of liquid on their corrosion rates as well as the corrosion products that form when using artificial urine were investigated. With a better understanding of corrosion, the viability of biodegradable zinc for ureteral stents was determined.

Why are you working on this project?

I chose this field as I was always interested in how engineering can directly be involved to help humans. Through the use of biomaterials, the lives of people can be improved. Biodegradable materials for example take this help to patients to another level, by potentially eliminating removal procedures. To this effect, the field of biomaterials and biotechnology is intriguing to me.

Being an athlete and sports fan, I am well aware of how certain injuries can be detrimental to careers if it were not for engineers that have come out with materials and designs to aid the procedures required. Although the use of biodegradable zinc in urological applications does not have much to do with the world of sports, it was interesting to me that the number of surgeries required can potentially be decreased by eliminating extraction surgeries in certain cases. This can be beneficial for the medical sector as it would reduce the load on doctors and hospitals as well as putting patients under less stress and pain.

Classification of Neural Disorders from fMRI Data using Machine Learning

Student: **Katrina Mugliett**
Supervisor: **Dr Kenneth Scerri** | Co-Supervisor: **Dr Claude Bajada**

What is your project about?

Attention Deficit/Hyperactivity Disorder (ADHD) is the most commonly diagnosed neural disorder in young children. The traditional procedure to diagnose children with ADHD is tedious and lacks objectivity. Studies have shown that there may be differences in the brain structure of children with ADHD and children without ADHD. Artificial Intelligence (AI) generally refers to the automation of tasks which would otherwise be performed by humans, and Machine Learning (ML) is an AI method through which patterns in data can be identified and used to make predictions on new data of the same type. The aim of this dissertation was to use ML to identify patterns in fMRI images of children with ADHD, and use those patterns to develop a method to predict whether a child has ADHD by simply processing an fMRI image.

Why are you working on this project?

The field of artificial intelligence and machine learning is advancing at a rapid rate. While these technologies are often met with scepticism, it is important for us to understand the science on which they are based. Through this understanding, it will become possible to employ intelligent technologies for the benefit of all humans. Great advantages can come from using machine learning in healthcare, including a better use of resources, unbiased, objective diagnoses, and efficiency in obtaining medical results. Neural disorders have severe negative impacts on the lives of those suffering from them and those around them. Machine learning can increase the efficiency and accuracy in the diagnosis procedure, thus allowing them to undergo the treatments necessary for them to improve their quality of life.

Development of an Automated Blood Perfusion System

Student: **Mario Parnis**
Supervisor: **Dr Inġ. Evan Dimech** | Co-Supervisor: **Dr Lourdes Farrugia**

What is your project about?

Provide a non-scientific/technical description of the project you are working on and the problem/s being tackled, which can be understood by the general public. This project is about researching and implementing a perfusion system for further microwave ablation experimentation on porcine livers. It is made up of a peristaltic pump, medical grade invasive blood pressure sensor and a flow sensor. The project involved interfacing via LabVIEW with the pump and sensors, their characterisation and signal filtering as well as some preliminary work on the integration of the whole system. The characterisation is required so that the behaviour of the sensor is known. The signal filtering involved experimentation to find the optimal window size for the moving average due to the pulsations of the peristaltic pump. The integration of the whole system is at a preliminary level and requires further medical research on the control strategy.

Why are you working on this project?

This area was selected as it is the intersection between electrical engineering and medical application. It applies knowledge learned during the course about electronic engineering as well as research on the medical application of perfusion systems. This project gave me the chance to apply topics learned during the course and thus allowed for further learning during the procurement and development stage. My interest in this work is mostly the instrumentation aspect. I was motivated to start developing the system and provide the basic building blocks for further development. This work is relevant to the public as it aids in microwave ablation research where such research is critical in developing the technique used as a non-invasive cancer treatment.

MOSFET Characterization for X-Ray Dosimetry

Student: **Therese Quattromani**
Supervisor: **Dr Inġ. Evan Joe Dimech** | Co-Supervisor: **Dr Inġ. Marc Anthony Azzopard**

What is your project about?

Following the discovery of x-rays in 1985, modern-day advancements in technology have provided various uses for x-rays, with those in the medical setting making up 99% of the x-rays humans are exposed to in our lives. The use of x-rays in medical imaging and radiotherapy could have immeasurable benefits on a person's well-being but there is also a risk which comes with the exposure to x-rays. Medical operators must make sure that the amount of x-rays administered is as much as necessary, not more, and not less. This brings about the need for an accurate, cost-effective and reliable measuring device which has been studied in this project.

Why are you working on this project?

Bioinstrumentation is the development of technologies for measuring and manipulating parameters in biological systems. The focus is on the application of technological tools for scientific discovery and for the diagnosis and treatment of diseases. I chose to work in this field to study and manufacture devices that improve healthcare and make it more accessible and affordable. Working in bioinstrumentation consists of the manufacture, calibration and constant improvement in of devices such as pacemakers, medical imaging, heart rate monitors, electrocardiographic devices and many more that help improve the quality of life of many people. I gained much knowledge into how technology is used in a medical setting and the immense rigor that is necessary to ensure that each patient receives the best possible treatment for their ailments. I have also learned much about the area of instrumentation in general which allows me to measure, observe and control real-life conditions.

Electrical Connection Test Set-up for MoM Tribocorrosion Losses Evaluation

Student: **Kersty Jo Zammit**
Supervisor: **Prof. Inġ Bertram Mallia** | Co-Supervisor: **Prof. Inġ Joseph Buhagiar**

What is your project about?

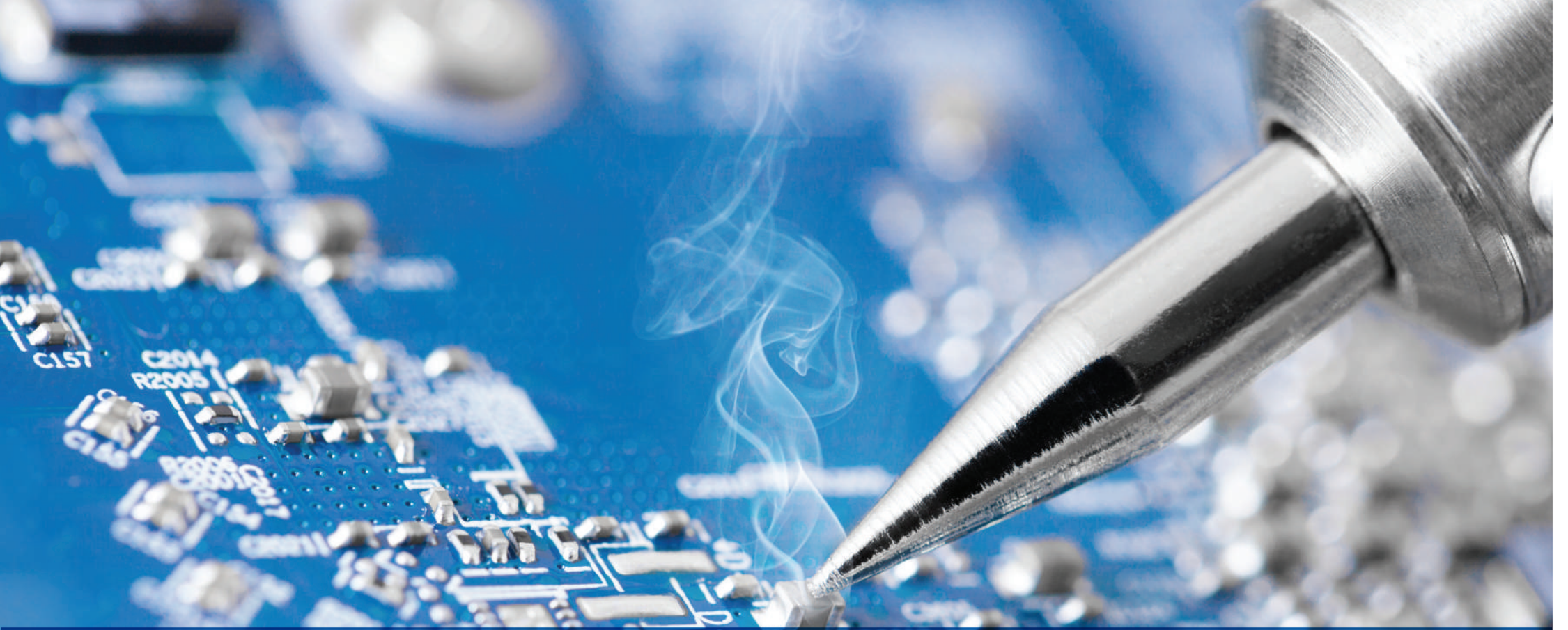
This project investigates the degradation of CoCrMo metallic biomaterials when subjected to rubbing against a metallic counter-surface in an electrolyte simulating salts in the synovial fluid. The material combination tested under this simultaneous action of mechanical wear and corrosion (tribocorrosion) consisted of a cast CoCrMo alloy sliding against a wrought CoCrMo alloy; two common biomaterials used in artificial hip joint bearing surfaces. CoCrMo alloys have excellent corrosion resistance due to a protective oxide layer which forms spontaneously on their surface. When this barrier layer is damaged during rubbing, it reforms but in the process material is lost by oxidation. During rubbing, surface layers called tribolayers could also form at the tribological interface which will have an effect on the extent of material loss. By means of an electrical connection set-up developed during this project, a controlled potential was applied to either or both of the materials forming the tribopair. The anodic current(s) generated representing the extent of material loss by oxidation during testing was recorded. This test configuration assisted in the analysis of the tribocorrosion response of this metal-on-metal configuration and evaluate the extent of oxidation and the possible formation of tribolayers at the contact surfaces.

Why are you working on this project?

My studies in material engineering and metallurgy stem from an interest to understand better mechanics of metal component degradation mechanisms, while also being intrigued by the complexities of biomaterial degradation.

Furthermore, through looking into the field of biomaterials, I have widened my knowledge and studies, getting a comprehensive understanding of material engineering and metallurgy. This multidisciplinary approach has broadened my viewpoint and has provided me with a varied skill set for tackling a variety of technical difficulties.

By understanding of corrosion-resistant materials behaviour under tribological and corrosive conditions, an opportunity for advancement in biomaterials is possible. Such developments will aid to improve the reliability and safety since enhancing the understanding of tribocorrosion, biomaterials can be enhanced to withstand higher amounts of wear and corrosion, thereby increasing the longevity of critical components of biological implants.



Section 2

Electronics Engineering

Development of a Standalone Multi-Stage Thermoelectric Module Controller

Student: **Gareth Blundell**
Supervisor: **Mr Andre Micallef** | Co-Supervisor: **Mr Alec Fenech**

What is your project about?

Thermoelectric Cooling (TEC) uses the Peltier effect to generate a temperature gradient when power is supplied to a semiconductor junction. Corresponding Thermoelectric Modules (TEMs) are manufactured to exploit this effect to its full extent, The performance of these setups may be increased by using multi-stage stacks which connects multiple such TEMs thermally in series. A product idea which originated from the ICECAP research project at the University of Malta was the motivation for this dissertation, where a Standalone Multi-Stage TEMC would be developed and made commercially available. This project develops a prototype on which the hardware for such a product may be implemented and tested. The final prototype may power up to 4 TEMs whilst sensing the temperatures obtained between each junction. It also supports USB communication for configuration and feedback during operation.

Why are you working on this project?

I have always been interested in Embedded System Design and the innovative products that emerge from it. This project allowed me to explore this field whilst applying knowledge that I learnt throughout the course, such as Printed Circuit Board (PCB) design and firmware development. Moreover, working on a project with commercial possibilities meant that I had to overcome challenges which are frequently faced in industry.

This project further contributed to the work done throughout ICECAP which may result in the integration of TEC in various sectors and applications. These include image sensor, vaccine, and optical transceiver cooling, each of which will benefit both the industry and the general public.

Calibration and Beamforming for a UHF Geodesic Phased Array Antenna

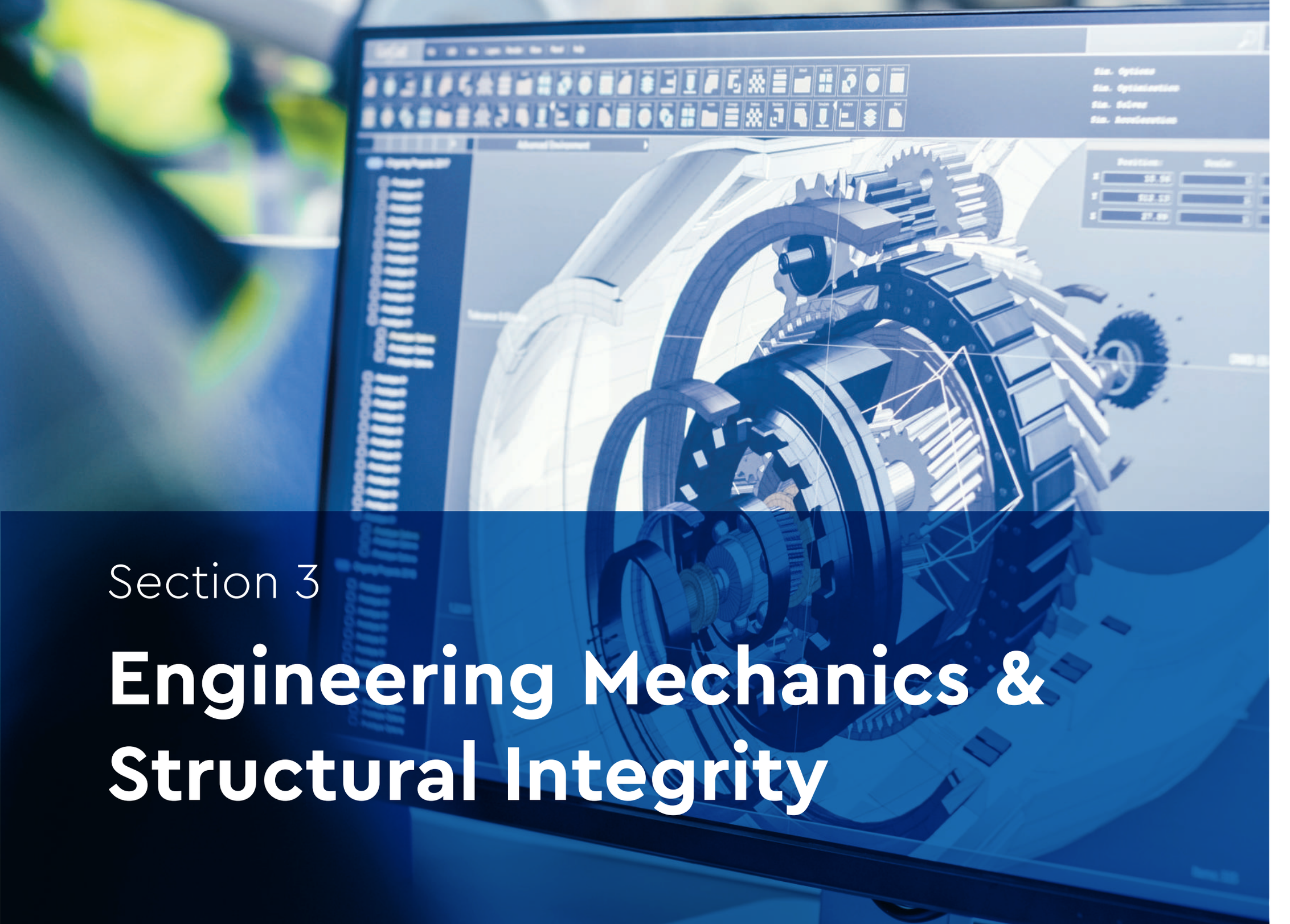
Student: **Curtis Casha**
Supervisor: **Dr Inġ. Marc Anthony Azzopardi**

What is your project about?

Recently, the focus of the space industry has shifted from launching large satellites, to launching constellations of miniature satellites, as these are cheaper and provide a lower risk of mission failure. The University of Malta is also planning to launch its own constellation of satellites. However, the traditional groundstation, making use of a motorised antenna is too slow tracking and communicating with such satellites. For this reason, the university has also started development on a phased array antenna, which can electronically control the radiation pattern by combining the contributions of multiple antennas. This project focuses on developing software to calibrate and generate communication beams using such an antenna.

Why are you working on this project?

Although phased arrays have existed for quite some time, the recent push towards higher frequencies and improved signal strength has led to an increased interest in phased arrays, especially for 5G applications and technologies such as Starlink. The unique ability of these arrays to track multiple targets and rapidly position communication beams means this technology will be at the forefront of future communications technologies. Apart from this, these arrays have also seen effective applications in military systems, enabling quick scanning of the sky to search for missiles, providing the capability of controlling multiple unmanned aerial vehicles and even being used to jam signals. By working on this project, I gained significant knowledge and experience in this advancing area of technology. Moreover, my interest in radio electronics and communications theory also pushed me to work on a dissertation which applied these concepts in a real-world application.



Section 3

Engineering Mechanics & Structural Integrity

Design by Analysis Using the Elastic Approach

Student: **Owen Galea**
Supervisor: **Prof. Ing. Martin Muscat**

What is your project about?

The dissertation explores the analysis of a pressure vessel design by making use of the EN 13445-3 standard for “Unfired Pressure Vessels” and ANSYS Workbench. The study employs the use of the assessment against static loading outlined in Annex C of the standard to verify design by rule results. The results which are obtained from the software are directly compared to specific stress limits which are decided upon by the stress categorisation methodology at each region under consideration. After analysing the results and comparing to both theory and published work, one can outline and address any regions which do not comply with the standard regulations. Hence, suggestions can be made which optimise the the design of the vessel.

Why are you working on this project?

The motivation behind choosing this project was the goal to obtain a comprehensive understanding of performing an analysis using design by analysis and the finite element method. Moreover, I have always found interest in the processes of design and validation. Hence, I could apply the knowledge I have gained to the validation of a pressure vessel which plays a critical role in various industries. Some of these industries include the oil and gas, chemical processing, and power generation industries. Failure to meet specific design requirements have can have severe consequences.

The project allowed me to obtain a better understand of the field of mechanics of materials and obtain knowledge regarding different modelling techniques and standard analysis procedures. Moreover, this project served as an opportunity to make use of what I have learnt during the past four years in engineering. Hence, regions out of specification could be, identified, analysed and improved.

Characterization of Kinetic Loads from Aerodynamic Induced Effects

Student: **Benjamin Abela**
Supervisor: **Dr Simon Mizzi**

What is your project about?

In the 2022 Formula 1 racing season, F1 racing teams were allowed to modify their cars’ undertrays so as to exploit the air flowing underneath the car. In doing so, the cars were able to generate more efficient downforces. However, due to unforeseen physical phenomena, the cars began experiencing a two-way interaction, which resulted in aerodynamic induced bouncing known as porpoising. Therefore, the aim of this project was to devise a computational method by which the interaction taking place between the car’s aerodynamic forces and the suspension dynamics could be simulated. Through these simulations, the kinetic loads and dynamic motion experienced by the cars and their drivers were examined in detail.

Why are you working on this project?

I have always been fascinated by the advancements made in the automotive industry. Particularly, my interest lies in the technology employed by the top tier motorsport racing industry, and how this technology has changed over the years. Recently, in the case of F1 racing, there has been a switch in the method used to generate downforce. Instead of focusing on the air flowing over the car’s wings, F1 teams are now directing their attention to the air flowing beneath the car’s undertray. The switch ended up resulting in porpoising, which when I saw for the first time intrigued me as a mechanical engineering student. I sought to understand the basis of the physical interactions taking place and how these were causing this phenomenon. Through this project and the employed computational method, the dynamic loads and interactions which such competition cars are subjected to, could be better understood.

Analysis of Formula Student Vehicle Suspension and Development of Load Acquisition System for Experimental Investigation

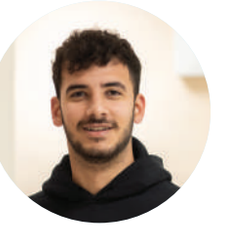
Student: **Cleaven Caruana**
Supervisor: **Prof. Inġ. Pierluigi Mollicone**

What is your project about?

This project presents a study on the analysis and measurement of the loads experienced by a double wishbone suspension system adopted by Formula Student vehicles. The study was applied to the University of Malta Racing team FC-20 vehicle for different design load cases. The experimental setup focused on applying noise mitigation techniques with an inexpensive load data acquisition system developed and verified to measure true loads from the vehicle's suspension system. After carefully calibrating the experimental setup and mounted to the Formula Student vehicle, the FC-20 was taken to a local racetrack, where it was driven at the design load cases to log true load data. The true load data was then compared to the loads calculated analytically.

Why are you working on this project?

This project combined my passion for engineering, motorsports, and innovative solutions. As a Formula Student enthusiast, I have always been fascinated by the intricacies of suspension systems and their impact on vehicle performance. The double wishbone suspension system is widely used in Formula Student vehicles, making it an ideal subject for analysis and improvement. Personally, I was motivated by the opportunity to contribute to the field of automotive engineering by developing an inexpensive load data acquisition system. By employing noise mitigation techniques and careful calibration, I was able to obtain accurate and reliable measurements of the loads experienced by the suspension system. This project allowed me to apply my technical skills, problem-solving abilities, and creativity to develop a practical solution for a real-world problem faced by racing teams. By studying and measuring the loads experienced by the double wishbone suspension system, we can gain valuable insights into its performance and identify areas for improvement.



Design, Build & Test of an Asymmetric Bending Experiment

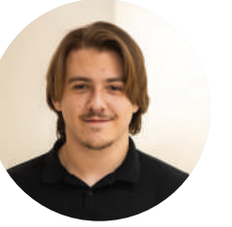
Student: **Nathan Kingswell**
Supervisor: **Prof. Inġ. Pierluigi Mollicone**

What is your project about?

The aim of this project was to create an asymmetric bending experiment to be used by undergraduate students during their studies. The phenomenon of asymmetrical bending occurs when, due to the nature of loading, a beam experiences deformation that consists of both bending and twisting. The design was developed through effective use of design tools. This design was then manufactured and assembled at the University of Malta, after which thorough testing was performed on the setup. These results were properly analysed through comparison with theoretical concepts, as well as data obtained through finite element analysis. Through this analysis, the effectiveness of the setup could be appropriately quantified.

Why are you working on this project?

Design has always fascinated me, as witnessing a project evolve from concept to a fully realized design is immensely rewarding. This inherent appeal drew me to this project. Additionally, the field of mechanics of materials is captivating in its own right. The development of theories in this field has constantly pushed the boundaries of what is achievable. It is incredibly satisfying to understand the intricate theories that underlie the physical phenomena we encounter in our daily lives. During my undergraduate studies I also found great joy in conducting lab experiments. The hands-on experience with equipment at the University of Malta and the practical application of theory were crucial aspects of my engineering education. Through this project, my hope is to provide future students with the same opportunity to use this experiment and gain invaluable hands-on experience that will complement their study material.



Lightweight Gate Structure

Student: **Clayton Sciberras**
Supervisor: **Prof. Inġ. Duncan Camilleri**

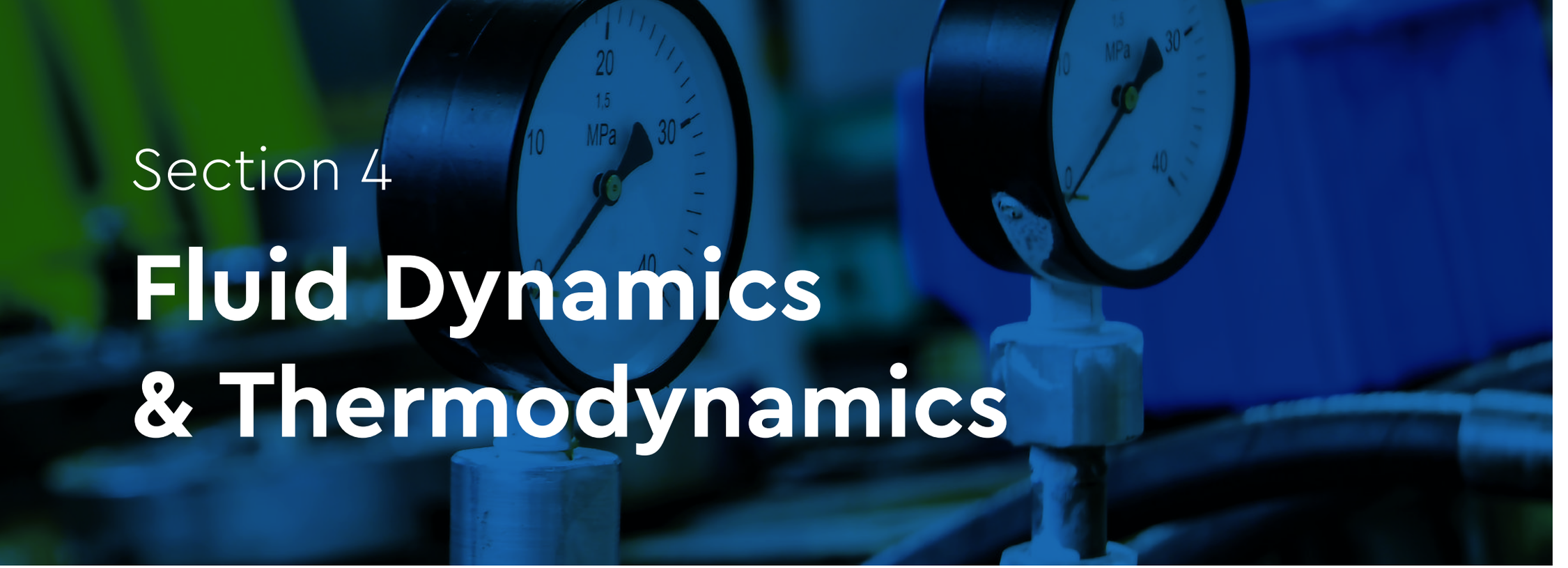
What is your project about?

This study involves the analysis of lightweight gate structures made from rectangular GFRP pultruded profiles. A new purely adhesive connection which connects two pultruded sections perpendicular to each other was designed, tested, and analysed. Material testing was conducted on the different cast resin to calcium carbonate filler powder ratios which were used throughout the study. Prototypes of the designed fitting were produced from four different materials to investigate which of these could be used in this application. Moreover, two custom-made, application-oriented testing jigs were designed and fabricated to facilitate the necessary experimental testing. Finally, the proposed fittings had to be cost effective to be produced in house at a local fibreglass company.

Why are you working on this project?

Engineering has been my passion since I was a child, I was and still am fascinated and curious with how things work. I selected this project because it hit two of my main interests, composite materials, and hands-on testing of the proposed solutions.

Composite materials, specifically GFRP pultruded profiles are a relatively newer material which have been introduced in the gate structures sector. This meant that few studies have been conducted on the material and necessary fittings for use in this sector. The limited fittings available on market led to the focus of this study. Moreover, the ideas studied in this project could possibly lead to new, better connections for GFRP pultruded profiles, not only to be used in gate structure applications but in the conjunction of GFRP pultruded profiles in other sectors. The possibility that my work could end up in industry made the project even more interesting.



Section 4

Fluid Dynamics & Thermodynamics

Deriving Aerofoil Data for Very Large Offshore Wind Turbine Blades using CFD

Student: **Keith Thomas Borg**
Supervisor: **Prof. Inġ. Tonio Sant** | Co-Supervisor: **Dr Jean-Paul Mollicone**

What is your project about?

Over the years, researchers have observed that one of the most effective means of decreasing the cost of wind energy is to increase the diameter of wind turbines. Currently, the average wind turbine power output for offshore installations is higher than that for onshore installations. However, this increase in diameter poses a significant challenge since larger wind turbines are subjected to highly complex air flows. Moreover, most aerofoil data currently available doesn't consider such complex air flow characteristics. Therefore, the main aim of this project was to derive aerofoil data, for the International Energy Agency (IEA) 15 MW reference offshore wind turbine, using Computational Fluid Dynamics (CFD).

Why are you working on this project?

Despite still being used in most countries, fossil fuels are a great concern to our environment, leading to global warming and climate change. However, fossil fuels are also of concern to our society and economy. Wind, on the other hand, is a safe, clean and unlimited source of energy. In all of this, large offshore wind turbines play a critical role. These wind turbines are especially suitable for countries which are surrounded by deep waters and have limited land available, such as the Maltese islands. However, the concept of very large offshore wind turbines is still considered to be in its initial stages and its significant potential may only be accomplished through continuous research and development. Therefore, the critical role played by wind energy in this urgent matter, whilst acknowledging the fact that more research is needed, is what made me eager to learn more and pursue this vast field.

Analysis of Waste Heat Recovery Pipe Configurations using Computational Fluid Dynamics

Student: **Julia Farrugia**
Supervisor: **Dr Jean-Paul Mollicone**

What is your project about?

The primary objective of this dissertation was to investigate the behaviour of cross heat exchange processes in heat recovery systems and to explore the potential benefits of implementing a square pipe for heat transfer augmentation. The study focused on several variables, including angles, inlet temperatures and system arrangements such as tandem and staggered configurations. For this purpose, Computational Fluid Dynamics (CFD) modelling technique was used in ANSYS Fluent 2022R2 software to perform both 2D and 3D numerical analyses. The aim of the study was to improve the understanding of the thermodynamic performance of heat recovery systems with regard to the study of flow.

Why are you working on this project?

I chose to undertake this project because industrial processes, particularly energy production, have contributed significantly to greenhouse gas emissions. As population growth and product demand continue to rise, increasing the efficiency of these systems has become a primary objective. Waste heat recovery systems have emerged as a potential solution, but their maximum potential can only be realised if they operate at their optimum efficiency. Given the urgent need to mitigate such an issue, I was motivated to apply my engineering background to contribute to this effort through research. In this project, my objective was to investigate the behaviour of cross-heat exchange processes in heat recovery systems and identify ways to enhance their thermodynamic performance. This is particularly crucial as the transfer of heat with respect to flow characteristics plays a vital role in determining the overall efficiency of these systems.

Investigation of the Positioning and Cooling of the Battery Pack on the Formula Student Vehicle

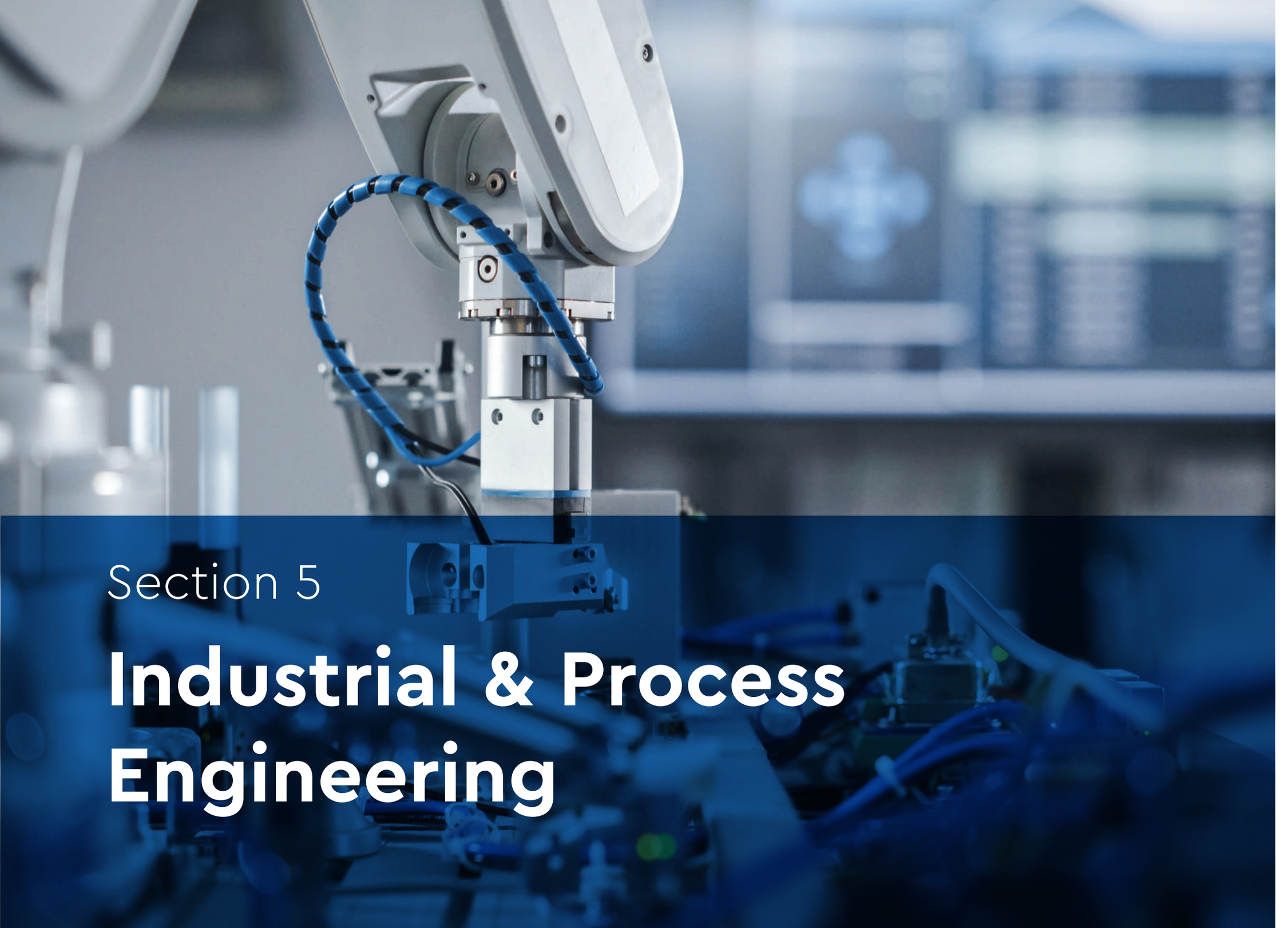
Student: **Kersten Xerri**
Supervisor: **Prof. Inġ. Christopher Micallef**

What is your project about?

The project focused on improving the positioning and cooling of a battery pack in a Formula Student vehicle using a technology called Computational Fluid Dynamics (CFD). This involved studying how the battery pack, which powers the electric vehicle, generates heat during operation and how that heat affects its performance. By using advanced computer simulations, different placement options and cooling strategies were analysed to optimize the battery pack's performance and prevent overheating. The aim was to ensure the battery operates efficiently, maintaining its power output while also extending its lifespan. This research contributes to enhancing the safety, reliability, and overall performance of electric race cars, paving the way for a more sustainable and high-performing future in motorsports.

Why are you working on this project?

I embarked on writing this thesis as an engineering student in my final year because I was deeply passionate about advancing electric vehicle technology, particularly in the context of motorsports. Electric vehicles have emerged as a promising solution for sustainable transportation, offering lower emissions and improved energy efficiency. However, in the highly demanding environment of a Formula Student vehicle, the efficient performance and thermal management of the battery pack are critical. By conducting research on the positioning and cooling of the battery pack using Computational Fluid Dynamics (CFD), I aimed to address these challenges head-on. I recognized the significance of optimizing the battery's performance and preventing overheating, not only to enhance the vehicle's speed and reliability but also to ensure the safety of the driver and surrounding components. This thesis provided an opportunity for me to delve into the fascinating field of CFD and contribute to the development of electric race cars.



Section 5

Industrial & Process Engineering

Factors Affecting Interface Bonding in Multi-Material Additive Manufacturing

Student: **Sarah Delia**
Supervisor: **Prof. Arif Rochman** | Co-Supervisor: **Mr Albert Curmi**

What is your project about?

The main aim of this dissertation is to understand the underlying mechanisms and factors that influence the interface bonding strength and quality of the bonds between two different polymeric materials produced as a single printed part. The process used in this study is known as filament fused fabrication multi-material additive manufactured (FFF MMAM), where multiple polymers in filament form are utilised in additive manufacturing (AM), also known as 3D printing. Understanding the influencing factors enables the optimisation of the printing parameters, selection of the material pairs including the printing order, and post-processing techniques to achieve stronger and more durable interfacial bonding. Thus, the study consisted of designing and testing of parts, and analysing the results.

Why are you working on this project?

I chose to work on this project as it focuses on additive manufacturing, a subject which I have always been interested in. Nowadays, additive manufacturing is being utilised due to its numerous advantages, hence its popularity within multiple areas in industry ranging from applications in robotics to the biomedical field. Although multiple studies on single-material additive manufacturing have been conducted, research on the application of multi-materials in additive manufacturing is still very limited, especially in terms of material combinations and the type of testing. As a result, this project gave me the opportunity to contribute to a topic that has not yet been thoroughly studied. This project incorporated both the industrial and materials engineering fields which allowed me to expand my knowledge in both fields and put into practice my problem-solving skills which I have acquired throughout this course.

Logistics Simulation of a Fabrication and Warehousing Facility

Student: **Andrew Sant**
Supervisor: **Dr Inġ. Emmanuel Francalanza**
Industrial Partner: **Vassallo Group**

What is your project about?

Thorough planning is crucial in the organisation of warehousing and storage facilities. An important element of this is the need to give ample consideration to the organisational structure when coordinating the movement of resources and materials. Since it is difficult and complex to represent this material flow using conventional pen-and-paper methods or ordinary CAD software, specialised approaches may be required. Nowadays, technology has rendered such an undertaking much less challenging. Virtual and augmented reality, plant logistics simulation, and other digital manufacturing tools help us visualise better the solutions being developed. This study examines the fabrication and warehousing facility at Vassallo Group with the aim of reaching optimal efficiency by maximising workflow and eliminating wasted resources.

Why are you working on this project?

I have selected this field of engineering as I am passionate about new technological techniques and to be able to learn a new computer skill which will be beneficial to my career later on. My personal motivation towards this work is to be able to work hand in hand with industry and have the opportunity to present my ideas and possibly later see the idea become a reality within the company. This factor motivated me to learn about an industry which I was not familiar with and allowed me to experience new manufacturing processes first hand. This work is relevant to industry as it provides a guideline to the approach that can be taken by other companies to be able to perform a similar task.

Machining of High Aspect Ratio Micro-holes in Steel using EDM

Student: **Chloe Magri**
Supervisor: **Dr Inġ. Pierre Vella**

What is your project about?

This project is an experimental study on micro holes and the maximum depths that they can be machined to, while still maintaining a high-quality result. Small accurate holes are difficult to drill in metal components and it is increasingly more problematic at higher depths. Very often, such holes are required for small component designs where there is no room for error.

The aim of this project is to identify the maximum diameter and depth ratio achievable while still maintaining a high-quality result. This is done by investigating what can be successfully achieved using EDM micro drilling, in terms of depth and dimensional accuracy, by utilizing different machining patterns and current setting to obtain the target results.

Why are you working on this project?

The demand for multi-functional products in compact sized devices is continuously growing. Therefore, the manufacturing industry has developed micro machining techniques and practices to accommodate these product requirements. In micro machining, the produced features are one millimetre or smaller, and so present unique challenges. Electrical discharge machining or EDM, is a process used for micro machining and micro drilling applications. The process uses controlled electrical sparking to remove material accurately and in a controlled manner, to form the desired component's shape. Using this technology, a series of micro holes were machined to investigate depth capabilities and their respective quality. Common applications of this machining technique include medical implants and micro valves. Without micro machining and its high accuracy capability, it would not be possible to produce such critical components. Developing high standard micro machining practices is very important to meet the design demands of modern industry.

Analysis and Development of Augmented Reality (AR) Technology for the Maintenance of Manufacturing Equipment

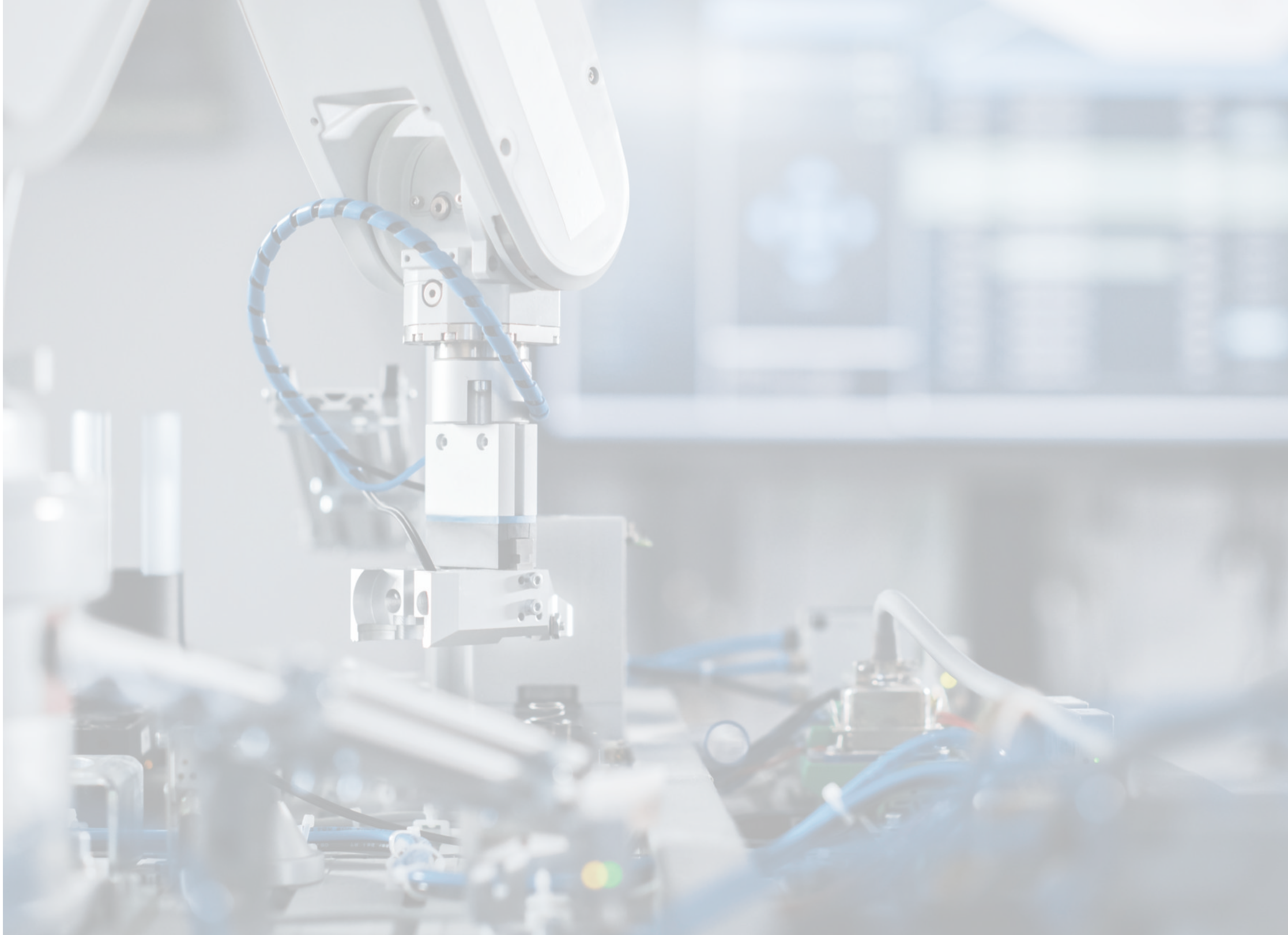
Student: **Andrea Bezzina**
Supervisor: **Dr Inġ. Joseph Paul Zammit**

What is your project about?

Several modern technologies have been introduced within the manufacturing industries, through Industry 4.0. This increased the complexity of the machinery used, and in turn, their maintenance processes. Augmented Reality (AR) is an Industry 4.0 technology, that has the potential to improve the way that the information required to conduct a maintenance task, is presented. This project investigates how AR can be adopted in manufacturing equipment maintenance. An AR application was designed and developed, using the Microsoft Hololens 2. This prototype was able to show how AR technology can help improve the user's understanding of maintenance tasks, when compared to the current methods being used in industry.

Why are you working on this project?

There are constant advancements in technology that have great potential to improve several sectors especially within the manufacturing industry. Augmented Reality (AR) is a technology that was introduced to the manufacturing world through Industry 4.0. This technology aims to combine the real world with the virtual one, by using sensors and display devices to add virtual objects to the real-world environment and allowing the user to interact with both at the same time. Through this project I was able to understand better the benefits that this type of technology can provide and find ways how to use AR to improve the maintenance processes of manufacturing equipment. Maintenance is a very important aspect within manufacturing companies as it helps reduce costs by preventing machine downtime. Therefore, it is imperative to find ways how to constantly improve maintenance processes.



Section 6

Maritime Engineering

Aero-Hydrodynamics of a Racing Sailing Yacht, Focusing on Sails, Keel and Rudder Design

Student: **Thomas Paul Fenech Adami**
Supervisor: **Prof. Inġ. Claire de Marco**

What is your project about?

The project involves the design of a performance racing yacht bare hull and adding a sail plan, keel, and rudder. Market research and yacht design ratios are used to correctly size the required ballast mass and sail area. Various ratios are used to size and define the geometry of the keel and rudder for a racing sailing yacht. Once the yacht is designed, the forces acting are calculated and the vessel is tested to predict its performance in various weather conditions.

Why are you working on this project?

The naval architecture sector has interested me for a number of reasons. Firstly, being brought up around boats I have been fascinated by different types of vessels. Sailing yachts, in particular, are extremely fascinating to me as they are the most eco-friendly mode of transportation, which have been around for centuries, harnessing the power of the wind.

Understanding the aerodynamics and hydrodynamics as well as the interaction between these forces is essential in the process of yacht design as they aid the designer to take numerous decisions to minimize the yacht resistance and hence produce a lighter, faster yacht. The project has made me appreciate yacht design greatly by understanding a fraction of the entire yacht design process.

An Experimental and Numerical Investigation of a Model Breakwater Concept

Student: **Kurt Spiteri**
Supervisor: **Prof. Inġ. Tonio Sant** | Co-Supervisor: **Ms Charise Cutajar**

What is your project about?

Floating and free-surface breakwaters are promising alternatives to conventional bottom-founded breakwaters. The overall aim of this project was to investigate the wave attenuating characteristics of a novel surface breakwater concept operating in the Mediterranean Sea. A combination of physical experiments and numerical modelling was used. A scale model was constructed and tested in the wave tank located at the Fluids Laboratory, at the University of Malta. Numerical simulations were carried out in order to validate the experimental findings. The limitations of both approaches were analysed in detail and documented. The combination of experimental and numerical techniques was shown to be a very useful decision-making tool to predict relative improvements in wave attenuation trends for variations in breakwater geometry.

Why are you working on this project?

My main motivation for working on this project was to understand the interaction of waves with offshore maritime installations. Furthermore, the provision of sheltered areas is fundamental for human settlements and for the protection of harbours and renewable energy generation technologies. The study is therefore highly relevant for Malta as an island state.

The project served as an opportunity to apply model scaling and wave tank testing, which are fundamental tools for the design of maritime technologies. My research has improved our understanding of small-scale testing in the preliminary design phase of offshore structures for the creation of sheltered areas. Over the past few years and through working on this project, I have furthered my interest in the offshore maritime industry. I intend to continue my studies and pursue a career in this sector.

Section 7

Materials Engineering

Fractographic Studies of Metal Components

Student: **Raffaella Baldacchino**
Supervisor: **Prof. Inġ. Glenn Cassar** | Co-Supervisor: **Dr Inġ. Ann Zammit**

What is your project about?

Catastrophic failures of industrial machinery, transportation vehicles and structures are often attributed to small standard engineering components, such as fasteners. Their failure may lead to irreparable damage, high costs and in some cases injury and fatalities. Therefore, by conducting fractography, which is a form of forensic engineering, the fractured surface of the fasteners can be investigated to better understand what has caused the components to fail. By conducting such investigations, improvement in the design, the material selection and the operating environment can be done to avoid future failure. In this study I focused on three main alloys, namely steel, stainless steel, and aluminium, applied heat treatment to simulate the mechanical properties of high strength fasteners and investigated their fractured surface to better understand their failure mechanism, in relation to their microstructural and mechanical properties.

Why are you working on this project?

Engineering has undoubtedly been my go-to area of study from a young age, as I like a hands-on approach to problem solving. I specifically chose the material science stream as I believe that it is a multi-disciplinary area of study, comprising of a combination of multiple sciences as well as providing a balance between the industrial and mechanical streams, which provides me with the necessary knowledge and tools to solve everyday problems. I selected this project as I was immediately captivated by the investigative approach that is required to better understand what causes components to fail. By using specific characterisation techniques, one is able to pinpoint the cause of failure, with minimal levels of speculation, and hence identify the source of the problem. I believe that this project is relevant to various industries as it can effectively reduce maintenance, repair costs, and injuries by taking actions to mitigate future failure.

Laser Shock Peening for Fatigue Resistance

Student: **Matthew Curmi**
Supervisor: **Dr Inġ. Ann Zammit** | Co-Supervisor: **Prof. Inġ Glenn Cassar**
Industrial Partner: **Council for Scientific and Industrial Research – National Laser Centre**

What is your project about?

This project forms part of a larger project called LaSPAAG: Laser Shock Peening of Automotive ADI Gears. Gears are prone to several forms of deterioration and failure with tooth-bending fatigue being the most prevalent failure mode. By employing a novel laser shock peening process, compressive residual stresses were induced beneath the near-surface of austempered ductile iron. These stresses were found to suppress the nucleation and propagation of fatigue cracks, therefore, increasing the fatigue performance.

LaSPAAG is an R&D project financed by TRAKE (University of Malta), with the main partners being the University of Malta and the Council for Scientific and Industrial Research – National Laser Centre in South Africa.

Why are you working on this project?

I have always been intrigued by nuclear power as a means of providing a reliable, safe source of carbon-free energy. Throughout the course, I was given several opportunities to read through literature on the performance of nuclear materials in a nuclear environment. A recurring issue in present nuclear reactors is that of radiation embrittlement. Put simply, the continuous collisions of nuclei and neutrons on the walls of a reactor induce atomic displacements that induce tensile stresses. These force open stress corrosion cracks which are not desirable. I also read about the effect of laser shock peening which was employed in Japan to suppress further radiation-induced cracks.

When the “Laser Shock Peening for Fatigue Resistance” was made available I immediately selected it as my first choice. I found this opportunity to work for the LaSPAAG project as a valuable means of furthering my knowledge of laser shock peening and its effect on the performance of materials.

Surface post-processing of Ti-6Al-4V lattices manufactured using electron beam powder bed fusion

Student: **Thomas Vella**
Supervisor: **Dr Inġ. Bonnie Attard** | Co-Supervisor: **Prof. Arif Rochman**

What is your project about?

Additive manufacturing is becoming increasingly important, with the capability of producing metal components with complex geometries. Ti-6Al-4V is a very useful titanium alloy used in aerospace applications and biomedical implants. Lattices are structures with engineered porosity which are renowned for their light weight. Electron beam powder bed fusion is a technique used to manufacture lattice structures. However, such components have poor surface finishes which are very rough, causing these to fail prematurely during application. The aim of this project is to improve the surface finish of these components using chemical post-processing techniques, such as acid immersion. Improving the surface finish can greatly increase the lifespan of Ti-6Al-4V components manufactured using this technique.

Why are you working on this project?

This project has allowed me to better understand metal additive manufacturing, whilst delving into surface post-processing treatment. Additive manufacturing has been of great personal interest for multiple reasons. Firstly, it is a growing sector which has only emerged around 35 years ago. It has great capabilities of producing components with complex designs and internal features. This is not possible with more common manufacturing techniques. This sector has the opportunity of producing specialised components, such as biomedical implants where individual patients can acquire personalised implants. Moreover, my work should improve the performance of porous lattices. Unfortunately, these lattices often have internal alloy powder which can become dislodged, which would be an issue especially for biomedical implants. Hence, post-processing of Ti-6Al-4V lattices can reduce the amount of sintered powder whilst ensuring the lightweight structures are capable of performing under high load scenarios.

Characterisation of Knight Armour from the Palace Armoury, Valletta

Student: **Laura Zerafa**
Supervisor: **Dr Daniel Vella** | Co-Supervisor: **Mr Matthew Grima**
Industrial Partner: **Heritage Malta Diagnostic Science Laboratories**

What is your project about?

The aim of this project was to analyse metal samples extracted from cavalry armour suits housed in the Palace Armoury in Valletta. The ultimate objective was to determine the composition of the metal and the slag inclusions through material analysis. By studying the chemistry of the slag inclusions, we could identify the process used to extract the steel for creating the armour. The presence of trace elements in both the metal and slag was examined to establish the origin of the steel and investigate any potential connections among the armour suits. This included determining whether they were sourced from the same region or produced in the same furnace. The armor being studied is believed to have been acquired from Northern Italy and dates back to the early 1600s.

Why are you working on this project?

Preserving and conserving historical artefacts should be given more importance. The examination of the metal fragments and slag inclusions can provide insights into the historical context of the armour suits. By physical examination of armour pieces, I was able to gather valuable information about the manufacturing techniques employed by armourers during the 1600s. Whereas through metallographic examination of the small metal fragments from the cavalry armour suits, I was able to learn about their composition and about the relationship of armour pieces from one suit of armour with those of another. This information will contribute towards preservation and restoration in order to ensure their long-term survival. Such research can enhance our understanding of the history, trade routes, and cultural connections of the time.

On a personal note, I have never worked in the area of historical artefacts conservation. Therefore, I thought that the combination of metallurgy and history would be the best way to expand my knowledge, whilst applying what I learned throughout the course practically and to the benefit of society, contributing to the preservation/promotion of its cultural heritage.

Improving the Mechanical Properties of Aluminum 7075-T6 by Shot Peening

Student: **Jamie Buttigieg**
Supervisor: **Prof. Inġ. Maurice Grech** | Co-Supervisor: **Prof. Inġ. Stephen Abela**

What is your project about?

Fatigue failures are failures that occur without warning, due to repeated loading, even if the load is well under the yield strength of the material. Fatigue failures are very common, and have been extensively recorded within the aerospace sector, among others. Provide a non-scientific/ technical description of the project you are working on and the problem/s being tackled, which can be understood by the general public. This project aims to improve the mechanical properties of Aluminium 7075-T6 by using shot peening, a process which uses tiny ceramic shots to deform the surface layer, inducing compressive residual stresses within. The resulting stresses at the surface resist crack propagation, which can be used to our benefit to increase the fatigue life of a component, i.e. the component can withstand more loading cycles before it fails.

Why are you working on this project?

I have chosen this project due to having personally witnessed an incident caused by a fatigue failure at Malta international airport. This incident was caused by a fatigue failure of a nose gear of a light aircraft, which ended up collapsing upon touchdown on Runway 23 and the aircraft came to a stop in the intersection where Runway 13 connects with Runways 23-05. The said incident resulted in full airport closure, with aircraft being diverted to Catania airport since the runways have been closed. Fatigue failures are common; however, the aerospace industry is at risk due to high cyclic loads imposed to airframes, which is combined with increasingly ageing fleets. Not tackling this problem would result in jeopardizing safety of passengers and bystanders alike. Past events such as American Airlines Flight 191 and United Airlines Flight 232 resulted in loss of life due to this kind of failure. Therefore, as a pilot, improving the safety of this industry would be highly beneficial.

Section 8

Product Development

Design of a Novel Medicine Packaging Solution for the Elderly

Student: **Alessandra Bianco**
Supervisor: **Prof. Inġ. Philip Farrugia** | Co-Supervisor: **Dr Nicolette Sammut Bartolo**

What is your project about?

Medicine packaging, namely tablet medicine bottles, can cause issues for the elderly in daily life, particularly when it comes to their opening mechanisms. This issue is compounded if an elderly person is impaired by conditions affecting cognitive and physical functions, including limited dexterity, strength and mobility in the upper limbs. For this reason, there is a need to design a more user-friendly medicine bottle for this target population whilst maintaining child-resistivity for an element of safety.

This project aimed to understand the current issues with medicine bottles and consequently design a novel medicine bottle for the elderly that is easy and simple to use, comfortable to handle, and child-resistant.

Why are you working on this project?

Current medicine packages can pose a problem to the elderly in daily practice, especially when opening them, particularly due to conditions such as Parkinson's Disease, osteoarthritis, and others. The development of a novel medicine bottle aimed at being easy to use and comfortable to handle would therefore help to mitigate the problems related to medicine bottles, including issues related to bottle ergonomics, opening mechanism and distribution of medicine. Such a solution would make life easier for the elderly, particularly those who choose to live independently.

The motivation for choosing this project stems from my interest in product design and the process through which one journeys from a conceptual idea to a physical design – rendering intangible ideas tangible.

Design of a Novel Sanitising Packaging Solution

Student: **Jeremy Balzan**
Supervisor: **Prof. Inġ. Phillip Farrugia**

What is your project about?

This project explores a novel sanitising packaging solution designed to enhance customer safety in takeaway shops. This innovative packaging solution combines two essential features: sanitisation and anti-tampering measures. By integrating a built-in sanitising mechanism, the packaging ensures that the customers sanitise their hands prior to consuming their ordered takeaway. Moreover, the anti-tampering aspect guarantees the integrity of the order, assuring customers that their food or beverages have not been compromised or interfered with during transit. The effectiveness and feasibility of implementing such a solution within the takeaway industry was evaluated with promising results achieved. This project contributed a step towards addressing the crucial need for enhanced hygiene and customer reassurance in today's fast-paced and health-conscious world.

Why are you working on this project?

The motivation behind working on this project stemmed from a deep concern for public health and a desire to address the growing need for improved safety measures in the food industry, particularly in takeaway shops. Recognising the potential risks associated with contamination and tampering, I felt compelled to explore innovative solutions that could effectively safeguard customers and restore confidence in the consumption of takeaway food. By developing a novel sanitising packaging solution with an anti-tampering aspect, I aimed to contribute to the well-being of individuals and the overall improvement of food safety standards. This project allowed me to combine my passion for design innovation and my commitment to creating a positive impact on society by ensuring the protection and well-being of customers in the takeaway industry.

Design of a Low Cost, Low Weight, Aesthetically Pleasing Prosthetic Knee

Student: **Laura Camilleri**
Supervisor: **Prof. Inġ. Jonathan C. Borg**

What is your project about?

In recent years, the prosthetics industry has become more technologically advanced with prosthetic knees incorporating smart features that enable them to adapt to different environments and movements by the user. However, as functionality increases, so do the prosthesis's price and weight. In fact, a user must be prepared to sacrifice some functional features, aesthetics and emotionally pleasing characteristics to purchase a low cost prosthetic knee. As a result, the prosthetics industry presents an opportunity for innovative designs to be created that offer above-knee amputees a lightweight, emotionally pleasing and affordable prosthetic knee.

Why are you working on this project?

My interest in biomedical engineering and product design served as motivation for this project. Before enrolling in the mechanical engineering course, I was interested in physiotherapy and sports-related degrees, but the biomedical engineering sector combines both. This field of engineering allows me to give back to the community. Creating a widely accessible knee prosthetic would significantly improve the quality of life and increase the level of independence of numerous amputees. This work is rewarding for both the designer and end-user since one inspires the other.

This project is relevant to today's industry because available prosthetic knees are expensive or lack functionality. If the user wishes to have a more appealing appearance for their prosthesis, the cost will increase further. Through this project it has been demonstrated that it is possible to design a prosthetic knee that is functionally sound, stylish, light and more affordable than other prosthetic knees available on the market.

Design of an Environmentally Friendly Cosmetic Package

Student: **Kieran Galea**
Supervisor: **Prof. Inġ. Jonathan C. Borg**
Industrial Partner: **TOLY Products Ltd.**

What is your project about?

The scope of this project was to design an environmentally friendly airless cosmetic package. An airless cosmetic package is designed to prevent air from entering the container and coming into contact with the product inside. This helps to preserve the quality and effectiveness of the cosmetic, as air can cause oxidation and spoilage over time. In light of this, to further enhance the environmentally friendliness of airless cosmetic packages, the boundaries set to define the environmentally friendliness of this new design were to make the packaging using only recyclable materials as well as reducing the material variety as possible and make the pumping mechanism modular to facilitate the disassembly and re-assembly of the components, thus only needing to dispose of the empty bottle once the cosmetic is consumed, rather than needing to dispose of the entire packaging.

Why are you working on this project?

I have chosen this area as I am very much interested in the design aspect of the engineering field. I am also very keen of innovation as I believe that engineering is driven by innovation, and in our daily life, we sometimes fail to see that innovation doesn't have to be a big wave, but even little ripples can affect our day to day lives.

With this project, I aimed to do just that, by only innovating one certain area in the entire packaging, the effects of this will leave repercussions that will continue to reduce our impact on the environment. This not only benefits our daily lives, but the lives of future generations, because as engineers, we are responsible not only for health and safety or for welfare but also for the sustainable development and designing for the future.

Analysis and Development of Virtual Reality (VR) Technology for a Virtual Learning Environment

Student: **Nathan Schembri**
Supervisor: **Dr Inġ. Joseph Paul Zammit**

What is your project about?

With the exponential increase in demand changes present in today's market, several companies established that the current education provided to engineers is no longer effective. Therefore, this project focused on creating and testing a virtual learning approach by using virtual reality to transfer knowledge to students. A virtual learning environment was created whereby one of the University laboratories was modelled on Unity, allowing students to navigate through the different areas within the laboratory while exploring the vast range of machines and equipment available. An evaluation was carried out and the results proved that the use of extended reality technologies in education is both engaging and effective.

Why are you working on this project?

This project was chosen as it deals with the challenge of improving knowledge transfer to engineering students. Throughout the engineering course, the lack of 3D visualisation together with the need for a higher level of experiential learning were some of the setbacks encountered. In education, virtual reality has a large potential to be used as a digital tool, as it enhances visualisation of learning content while also promoting active learning, which is beneficial in improving knowledge transfer. The virtual learning environment adopted in this project bridges the gap between theory and practical learning by using visual aids to teach theoretical content, while using interaction to enhance experiential learning. Implementing extended reality technologies in education enhances student interest and engagement while also improving knowledge retention. In my opinion, the shift to virtual learning approaches is the next step in both education and industrial settings as this can be considered as the future of learning.

Section 9

Robotics, Automation & Control

Automation during Additive Manufacturing – A Case Study for 3D Printed Smart Wearable Device

Student: **Svetlana Mifsud**
Supervisor: **Prof. Inġ. Philip Farrugia**
Industrial Partner: **Invent 3D Ltd**

What is your project about?

The research project SMARTCLAP led by the Department of Industrial and Manufacturing Engineering (DIME) at the University of Malta, focuses on the design of DigiCLAP, a smart wearable device aimed at assisting children with Cerebral Palsy in improving their hand skills through an Augmented Reality (AR) serious game. This project is funded by the Malta Council for Science and Technology (project reference no. R&I-2019-003-T) and it combines technology and therapy to provide an innovative and user-centred solution for children with Cerebral Palsy. As part of this project, my focus is on developing an automation system specifically for the 3D printing process of DigiCLAP. The objective is to create a fully automated manufacturing system that streamlines the production of the device. By automating the 3D printing process, we aim to enhance efficiency, consistency, and scalability, ultimately making the DigiCLAP device more accessible to children with Cerebral Palsy.

Why are you working on this project?

The prospect of contributing to the SMARTCLAP project, centred around the development of the DigiCLAP smart wearable device for children with Cerebral Palsy, has deeply resonated with me. The opportunity to contribute to such a meaningful and impactful project was incredibly appealing to me. As someone with a strong interest in automation and additive manufacturing, I was particularly excited about working on the automation aspect of this project, specifically focusing on the 3D printing and assembly process of DigiCLAP. I strongly believe that automation can play a crucial role in improving the efficiency and reliability of manufacturing processes, ultimately benefiting children with Cerebral Palsy and their therapists. By automating the production of DigiCLAP, we can ensure consistent quality, reduce production time, and enhance scalability. The relevance of this project to the general public is undeniable. By developing an automated manufacturing system for DigiCLAP, we can accelerate its accessibility and affordability, making it more available to children with Cerebral Palsy worldwide.

Designing Collaborative Robotic Experiences in Manufacturing Environments

Student: **Kayleigh Degiorgio**
Supervisor: **Dr Inġ. Emmanuel Francalanza**
Industrial Partner: **Methode Electronics Malta Ltd.**

What is your project about?

Automation has revolutionised manufacturing environments, particularly through advancements made in robotics. Even with this increased automation, however, human input and skill are still essential, and often irreplaceable. The downside of this, however, is the physical toll certain manufacturing operations can have on the human body. To aid operators tasked with manual work, this project investigates the integration of collaborative robots (cobots) within manufacturing environments not initially designed to be collaborative. Since cobots are inherently safe, they can occupy the same space as the operator; while the cobot handles the more physically strenuous and repetitive tasks, the operators can focus their efforts on the more intuitive, less physically demanding, tasks.

Why are you working on this project?

Automation is a guarantee in today's world, where the continuous improvements being made optimise our processes even further and expose new possibilities. This is therefore a highly dynamic field in engineering, and so it is one which highly interests me. With more advanced automation, many fear the replacement of humans with robotics and technology. However, the specific engineering field of collaborative robotics eliminates this fear, as its purpose is to aid humans in their work, and not replace them. This was my main motivation in choosing such a research area; finding the right balance of automation to enhance manufacturing processes, while aiding the operators and improving their work tasks. This work is therefore relevant to the industry as it aims to bridge the gap between manually intuitive tasks requiring human input and the need for further automation to enhance the productivity.

Optimization of Compressed Air Systems in Industrial Automation

Student: **Daniel Baldacchino**
Supervisor: **Dr Inġ. Emmanuel Francalanza** | Co-Supervisor: **Dr Paul Refalo**

What is your project about?

In industrial automation, compressed air is typically used to power pneumatic equipment. However, several leaks become frequently present in compressed air systems reducing overall efficiency and increase operational costs. This dissertation proposes to minimize the effect of leaks by optimizing compressed air system parameters like pressure and air flow using artificial intelligence techniques as part of the implementation of an appropriate control strategy to enhance system performance. Testing and experimentation were carried out to understand the behaviour of pneumatic systems by collecting data samples and validating them across mathematical principles. Once data was validated, mathematical models were developed and used part of an AI algorithm. The research contributes to the field of industrial automation by improving the sustainability and efficiency of compressed air systems.

Why are you working on this project?

I selected this area of engineering, specifically because of its hands-on nature and the exciting challenges it presents. As I delved deeper into the field, I realized the immense impact that it had on the automation world. Whether it's designing innovative solutions to improve efficiency, or developing sustainable technologies, this field plays a crucial role in shaping the world we live in. My personal motivation and what interests me about working in the field of engineering, particularly in the context of integrating AI, are the incredible opportunities it presents for innovation, problem-solving, and making a positive impact on society. AI has the potential to revolutionize various industries and domains by enabling machines to learn, adapt, and make intelligent decisions. The work of integrating AI into engineering, particularly in improving the sustainability of compressed air systems (CAS), is highly relevant to both the general public and the industry. The relevance of this work extends beyond individual companies and industries. As energy efficiency and sustainability become increasingly important global priorities, engineering advancements that address these issues have a broader societal impact. By improving the sustainability of CAS through AI integration, we contribute to the collective effort of reducing carbon footprints and promoting responsible resource management, benefiting not only the industry but also the general public by fostering a cleaner and greener environment.

Autonomous Ground Vehicle Guidance

Student: **Salah-Ad-Din Ahmed Youbi**
Supervisor: **Prof. Inġ. David Zammit Mangion**

What is your project about?

The aim of the project is to create a system to enable ground vehicle such as a car to be autonomously guided along a pre-programmed path. The system uses an IMU (inertial measurement unit) to find the vehicle state (position and orientation) to diverge the vehicle's trajectory to the pre- programmed paths. The control algorithm used for this mission is the pure pursuit algorithm. The resultant code is to be tested using in-loop simulation, with the PC performing the function of the IMU in terms of estimating the vehicles position and returning it to the microcontroller running the algorithm.

Why are you working on this project?

I have chosen to focus on tracking algorithms since it is a field that combines my desire to become an engineering with my desire to further people's standard of living. I also have a reasonable exposure to control theory and dynamic systems and signals. Some applications require work to be done in areas unaccusable or hazardous to human workers. Hence, autonomous vehicles come be used in such environments and equipped with different tools to accomplish the required task. This provides greater safety and potential for discovery for human beings as autonomous vehicles can cover dangerous and difficult jobs such as: bomb disposal, intelligent vehicle/highwaysystems, planetary rovers and military application. With autonomous vehicle control it is possible to make our roads safer true automated vehicles that reduce accidents, even search for new resources on extra terrestrial bodies and carry out dangerous research in caves or deep oceans with no danger for human life.

Design & Prototyping of a Telerobotic System for Surveying an Archaeological Underground Space

Student: **Ms Natasha Micallef**
Supervisor: **Prof. Inġ. Michael A. Saliba** | Co-Supervisor: **Dr Inġ. John Charles Betts**

What is your project about?

The aim of this project was to design and build a custom robot prototype for the Department of Classics & Archaeology in University of Malta, which can be used to explore archaeological underground spaces remotely.

The robot was named “TRex”, short for Telescopic Reach Explorer, after its telescopic arm design. Once placed above an opening, it lowers down and extends its arm outwards with a camera to capture clear images in the darkness.

TRex was designed to be compact in order to fit into small openings that are otherwise inaccessible, while insuring affordability, sustainability, power efficiency, and user-friendliness. Additionally, locally sourced parts were used to support quick maintenance and repair.

Why are you working on this project?

During my years studying engineering at the University of Malta, I have recognized an unevenness in the distribution of technological advancements across various fields. Certain sectors receive concentrated attention and resources, while others are neglected due to financial constraints or a lack of societal support.

Archaeology has been a lifelong passion of mine, and having the opportunity to apply engineering principles to develop a concept primarily focused on archaeological use has been a tremendous accomplishment and a source of great honour for me. It is a unique blend of my two passions, allowing me to contribute to the field of archaeology through innovative engineering solutions.

Section 10

Sustainability & Energy Efficiency

Development of a Microplastic Filtration Methodology for Graphene-based Filters

Student: **Alexandra Bartolo**
Supervisor: **Dr Inġ. Anthea Agius Anastasi** | Co-Supervisor: **Prof. Inġ. Glenn Cassar**

What is your project about?

Graphene is a two-dimensional sheet of carbon with the ability to attract and adhere to plastic. In this form, however, graphene is so thin that it can only be seen under a microscope, and is therefore of little use for filtration purposes. By applying certain processes, the individual sheets may be stacked on top of each other, becoming thicker and stronger, eventually forming into a three-dimensional structure as thick as a few centimetres, including numerous microscopic pores. This project involves testing the capability of such porous graphene structures to filter out micro- and nano-sized plastic particles from water, accomplished by designing customised apparatus which can be modified to house graphene-based filters of various shapes and sizes.

Why are you working on this project?

I have always been passionate about the environment, and frequently found myself discouraged by the many threats it faces, therefore, the possibility of helping to provide a solution immediately interested me. The presence of micro- and nano-sized plastic particles in the water bodies that surround us has become a major crisis, owing to the ever-growing plastic production industry that is simply unmatched by the relatively sluggish improvements in plastic recycling rates. This combination leads to a significant amount of long-lasting waste plastics becoming landfilled, and eventually ending up in the ocean, where they break down into small fragments. At this point, the fragmented plastics enter the food chain eventually reaching humans, causing as-yet unidentified long-term effects. It is for this reason that I was motivated to work on the development of technologies to filter such particles out of water as it will benefit the general public by ultimately solving a global environmental crisis

Design of an Accelerated Weathering Chamber and its Implementation for UV Ageing of Microplastics

Student: **Jack Galea**
Supervisor: **Dr Sophie Briffa** | Co-Supervisor: **Dr Inġ. Anthea Agius Anastasi**

What is your project about?

Plastics are undoubtedly an essential part of our lives. However, their improper disposal into the environment has led to their breakdown into small debris, known as microplastics. Microplastics have found their way back into our daily lives, in drinking water, fruits, and even breast milk. Scientists are therefore trying to replicate the breakdown of plastics to understand what effects microplastics have on human health. This project contributes towards this goal by building a weathering chamber that simulates Maltese shore conditions; exposing plastic to UV rays, seawater, and sand abrasion. Chemical and physical changes caused by weathering were then investigated.

Why are you working on this project?

Sustainability has always been important to me, in all aspects of life. I believe that if future generations have the right to enjoy a clean environment, then we have the responsibility of taking care of it. So it was only natural for me to select a final year project that would educate myself on one of the largest threats that the environment is facing. The project also provided an interesting challenge as the field of research has only seen real interest in the last decade and therefore, is lacking standardised procedures. This made it all the more satisfactory to contribute towards a goal which requires more research and is seeing more and more growth. Lastly, I believe that everyone can contribute towards this goal in their own way, either by conducting research in the lab, or simply taking a coffee mug with you to work to avoid a single-use plastic cup.

Comparing the Photocatalytic Behaviour of Two different Zirconium Based Coatings with Nanotextured Titanium Dioxide Surface

Student: **Lars Mercieca**
Supervisor: **Prof. Inġ. Stephen Abela** | Co-Supervisor: **Prof. Inġ. Maurice Grech**

What is your project about?

Water scarcity is a pressing global challenge influenced by population growth, urbanization, and climate change. To combat this issue, a new contemporary method called photocatalysis, which offers a cost-effective and eco-friendly solution by destroying contaminants in polluted water, thereby reducing the strain on fresh water sources. Photocatalysis is a method in which a material is immersed in the polluted water and exposed to UV radiation; thus a chemical reaction occurs on the surface of the material, destroying the polluted contaminants in the water.

Why are you working on this project?

I have chosen to focus on tackling water scarcity through photocatalysis because it is a field that combines my passion for engineering with my desire to address pressing environmental issues. Water scarcity is a global challenge that affects millions of people, and traditional water treatment methods are often expensive and energy intensive. Personally, I am motivated by the potential impact this work can have on improving access to clean water and promoting sustainable development. The ability to apply scientific principles and engineering concepts to develop innovative solutions is both intellectually stimulating and fulfilling. I am particularly interested in exploring new materials to tackle this problem. With photocatalysis, we can develop cost-effective and environmentally friendly water treatment technologies that are accessible to communities in need. This work also holds immense value for industries that rely on clean water, such as agriculture, manufacturing, and energy production. Ultimately, the advancements in photocatalysis have the potential to revolutionize water treatment and contribute to a more sustainable future for all.

Life Cycle Assessment of Cosmetic Packaging Scenarios

Student: **Nicole Vassallo**
Supervisor: **Dr Inġ. Paul Refalo**
Industrial Partner: **Toly Products Ltd.**

What is your project about?

The aim of my project was to evaluate the environmental impact of different cosmetic packaging approaches by analysing the sustainability efforts of popular cosmetic brands in developing more eco-friendly packaging. With the continuous rise in demand for beauty products, the global cosmetic packaging market has witnessed significant growth, leading to a considerable increase in packaging waste and its negative effects on the environment. By examining factors such as packaging quantity, material composition, energy usage, and disposal methods, effective strategies for producing sustainable packaging in various scenarios were identified.

Why are you working on this project?

My interest in environmental sustainability sparked during a physics lesson in secondary school, and since then, I have actively pursued electives focused on sustainable practices in industry. Learning about the amount of packaging waste generated by individuals annually led me to explore sustainable approaches to cosmetic packaging. This exploration aimed to uncover potential strategies for mitigating the environmental consequences associated with such waste. This project provides valuable insights for Toly Products Malta and the cosmetics packaging industry by offering a comprehensive understanding of the environmental advantages associated with modifying different packaging attributes. While I appreciate and commend Toly's exploration of different sustainability approaches, I also gained a deeper understanding of the significant influence consumers have on shaping the environmental footprint. This is particularly true in terms of end-of-life disposal, where manufacturers like Toly have limited control, as consumers ultimately determine the product's fate.

Compressed Air Control for Sustainable Pneumatic Systems

Student: **Redent Abela**
Supervisor: **Dr Inġ. Paul Refalo** | Co-Supervisor: **Dr Inġ. Emmanuel Francalanza**
Industrial Partner: **AIM Enterprises Ltd**

What is your project about?

The main goal of this project was to design several functions that reduced the effects of leaks on the energy efficiency of a compressed air system. The functions made use of readily available components that allowed for control of the system's operating parameters, such as pressure and flowrate. By varying these parameters, air consumption was significantly reduced while the system was operating with different leaks present. A pick and place system was used for this project since this type of system is used throughout industry, thus the results obtained could also be implemented in different manufacturing facilities.

Why are you working on this project?

From a background of repairing and restoring cars, compressed air systems have always intrigued me as they are used throughout this specific industry for many different purposes, such as spraying and operating pneumatic tools. Apart from this, compressed air systems are also used throughout the manufacturing industry, thus this project allowed me to gain specific knowledge that is useful in many different facilities.

This project's focus on sustainability was also a topic that is important to me, since the state of the environment is on a rapid decline into an irreversible catastrophe. With the efforts of this project combined with the works of past and future students, the sustainability of industrial compressed air systems will be increased, allowing for more sustainable production processes and thus more sustainable products.

Analysis of the Energy Consumption of 3D Printing

Student: **Ruth Psaila Brancaleone**
Supervisor: **Dr Inġ. Paul Refalo** | Co-Supervisor: **Prof. Arif Rochman**

What is your project about?

3D printing is an additive manufacturing technique that has gained popularity over recent years both in industry and for personal use, mainly due to its ability to produce detailed and customizable parts. The aim of this project was to analyse how two 3D printing techniques, Fused Filament Fabrication (FFF) and Fused Granular Fabrication (FGF), compare to each other in terms of energy consumption and final part quality. FFF is a common 3d printing technique that utilizes filament material, whilst FGF utilizes material in granular form. The effects of different process parameters on the resource consumption and part quality for each printing technique were also analysed.

Why are you working on this project?

The technology of 3D printing has advanced considerably in the last few years, and consequently, so has its application in the manufacturing industry. Sustainability in manufacturing has become an increasingly important consideration due to the emissions produced and their negative impact on the environment. The resource consumption of 3D printing, including energy and material consumption, is, therefore, a topic of great concern. Even though research on both new 3D printing technologies and the relationship between 3D printing and sustainability is considerable, research concerning fused granular fabrication is still lacking. The effects of 3D printing on resource consumption are not only of interest to the industry but also to individuals interested in 3D printing. Carrying out this project has helped further my knowledge and put into practice what I have learnt during this course.

The Monitoring and Control of the Energy in a Production Plant

Student: **Beppe Attard**
Supervisor: **Prof. Inġ. Joseph Cilia** | Co-Supervisor: **Inġ. Neville Azzopardi**
Industrial Partner: **Abertax Technologies Ltd.**

What is your project about?

The recent increase in energy prices experienced by the industrial sector has enticed consumers to invest in renewable energy sources, such as solar photovoltaic systems, to meet their energy demand and reduce their energy costs. However, during a power outage, industrial consumers use diesel-powered generators to produce the required energy and thus, the photovoltaic systems are not operated since the utility grid is unavailable. Therefore, in this project, a system was designed and implemented so that in the event of power outages, the PV systems can be connected in parallel with the diesel generator, thus reducing fuel costs.

Why are you working on this project?

This topic was selected because, in the world energy climate that we are currently in, the use and optimisation of renewable energy are of utmost importance. Therefore, in emergency scenarios which lead to power outages, solar energy must be utilised to reduce fuel consumption and carbon emissions. The project involved different areas of great interest and provided me with the motivation required to complete this project. These areas include photovoltaic energy, industrial electrical power and automation. The work completed in this project can be applied in various industrial and commercial sectors to reduce their cost of production in emergency situations. Moreover, this system can be used in areas where energy is not readily available such as in underdeveloped countries, to support their energy generation.

Section 11

Transportation

Investigating Euro 6 Diesel Vehicle Emissions After-treatment using Chassis Dynamometer and CAN-bus data

Student: **Thor Scicluna**
Supervisor: **Prof. Inġ. Mario Farrugia**

What is your project about?

Euro 6 Diesel vehicles incorporate emission-reducing technologies comprised of filters (DPF) and catalysts (Urea-SCR) to reduce harmful exhaust by-products, mainly soot and nitrogen oxides (NOx). Accurate measurement of specific NOx and oxygen levels in exhaust gases is crucial for evaluating these technologies' effectiveness. This required the analysis, calibration and recording of digital messages transmitted from NOx sensors located within the exhaust system. Testing was then performed using a chassis dynamometer to deduce the effectiveness of DPF and Urea-SCR in allowing diesel vehicles to comply with modern emissions regulations.

Why are you working on this project?

The intricate mechanisms and systems found in the automotive industry have always been of great intrigue to me, driving my desire to understand how they work with an aim to someday contribute to their design and development. This passion for exploring the inner workings of automotive technologies was a great influence into my decision to pursue thermodynamics, being the branch of engineering most related to internal combustion engine research and development. This project analyses the efficacy and possible drawbacks of common diesel vehicle exhaust after-treatment technologies, aiming to gain insight on the indispensability of such devices in maintaining urban air quality in a highly environmentally conscious market.

Benchmarking Optimised Camshaft Profiles for an FSAE Vehicle

Student: **Aidan James Azzopardi**
Supervisor: **Prof. Inġ. Mario Farrugia**

What is your project about?

Valve overlap is a mechanism used to draw in more fresh air in the intake by using momentum from the exiting exhaust gases. However, with increased boost from the turbocharger, a portion of fresh air is wasted in the exhaust. In a previous project a set optimised camshafts were designed and manufactured but never tested on a physical engine. Therefore, the Kawasaki ZX6R engine setup was modified with additional sensors to benchmark the optimised camshafts with the OEM variants. Mass air flow, volumetric efficiency, torque and fuel consumption results for both camshafts were tested and compared. Finally, simulations using Ricardo Wave were carried out to compare experimental results with simulations and exhaust valve timing anchors was investigated.

Why are you working on this project?

Thermodynamics deals with the topic most commonly associated with engineering, engines. I have always been intrigued by process of optimising internal combustion engines to extract the maximum potential. In today's world it is important more than ever to create energy efficient engines. From a young age the sound of a roading engine has always been of great interest to me. When I enrolled to become an engineer, my aim was to apply theory learnt in class to projects like this. Throughout my journey as a university student, I have been heavily involved in Formula Student, which has given me the opportunity to design, build and race a formula style race car against other universities at international events. The experience fuelled in me a greater interest in automotive racing applications which led me to this project. Technological advancements made in the motorsport field are vital to the automotive world since technologies found in daily driven vehicles originated from motorsport applications.

Electro-Magnetic Design and Analysis for a High Performance, Aerospace Electrical Machine

Student: **Christian John Dalli**
Supervisor: **Prof. Inġ. Michael Galea** | Co-Supervisor: **Prof. Joseph Cilia**
Industrial Partner: **Abertax Ltd.**

What is your project about?

The ever-increasing need for more sustainable modes of transport is escalating the demand for higher performance electrical machines. For these machines to be of practical use in real-world applications, their respective power and torque density must increase. Permanent Magnet Synchronous Motors (PMSM) are renowned for their capacity to be both power and torque dense, however the requirements are still very challenging to achieve.

A 30kW PMSM is to be designed and analysed for use as a high performance, aerospace electrical machine. The scope of this motor is to be used in conjunction with a propeller as the main propulsion for a two seater all electric aircraft.

Why are you working on this project?

Aerospace engineering was always a passion of mine. The idea of pushing current technology to its highest potential intrigued my interest. Moreover, I am able to contribute to the research and development of electrified propulsion for all electric aircrafts. The current pursuit towards more sustainable transportation is pushing the industry towards heavier electrification, particularly the development for higher performance electrical machines (EM). With carbon emissions being at the lead of environmental concerns, the aerospace industry is forced to reduce its carbon footprint and transition towards more sustainable practices. Novel design processes and methodologies were required for the electrical machine to achieve the performance standards required for aerospace applications. A multi-disciplinary approach consisting of both electro-magnetic and thermal models is proposed and validated. Using Finite Element Methods, geometric models of the stator, rotor, and magnets have been constructed and optimized. Improvement techniques and analytical methods were applied to optimise the results and ensure that the machine reaches both its magnetic and electric limits.

RS GROUP

TCC group
Excellence Through Diversity

- **Over 500,000 stocked lines from leading global manufacturers and technology providers.**
- **Market leading inventory levels ensuring immediate availability for prototype and volume production.**
- **Slash valuable time you spend in sourcing Electronic Components.**
- **50,000 parcels shipped daily**

Visit us at mt.rsdelivers.com or contact sales@thetccgroup.org

RS PRO · OSRAM · RENESAS · ON Semiconductor · maxim integrated
VISHAY · Panasonic · TDK · Raspberry Pi · ANALOG DEVICES
Infineon · MICROCHIP · CYPRESS · KEMET · TE connectivity
BROADCOM · molex · WÜRTH ELEKTRONIK · Amphenol Industrial · life.augmented

---

TCC group
Excellence Through Diversity

FORTIVE




Calibration Services

Our experienced technicians and specialized equipment are ready to calibrate instruments of the following types:

- Avionics Calibration
- Communications Calibration
- Electrical / Electronics Calibration
- Fiber Optic Calibration
- Flow Calibration
- Force Calibration
- Gauge Calibration
- Humidity Calibration
- Logic Analyzer Calibration
- Medical Equipment Calibration
- Oscilloscope Calibration
- Telecom Calibration
- Physical / Dimensional Calibration
- Pipette Calibration
- Precision / Mass Calibration
- Pressure Calibration
- RF / Microwave Calibration
- Sound Calibration
- Temperature Calibration
- Thread Gauge Calibration
- Analog Meter Calibration
- Coaxial Calibration
- Digital Meter Calibration
- Multimeter Calibration
- Torque Calibration

Contact TCC: sales@thetccgroup.org

FLUKE · KOLLMORGEN (Because Motion Matters™)
GILBARCO VEEDER-ROOT · Portescap
TELETRAC NAVMAN · PACIFIC SCIENTIFIC ENERGETIC MATERIALS COMPANY
setra · THOMSON (Linear Motion. Optimized.™)
QUALITROL · Tektronix


enemalta
POWER
YOUR CAREER
#ENGINEERING
JOIN US
unique work on the national power grid
opportunities for growth, continuous development
fresh graduates
high retention rate