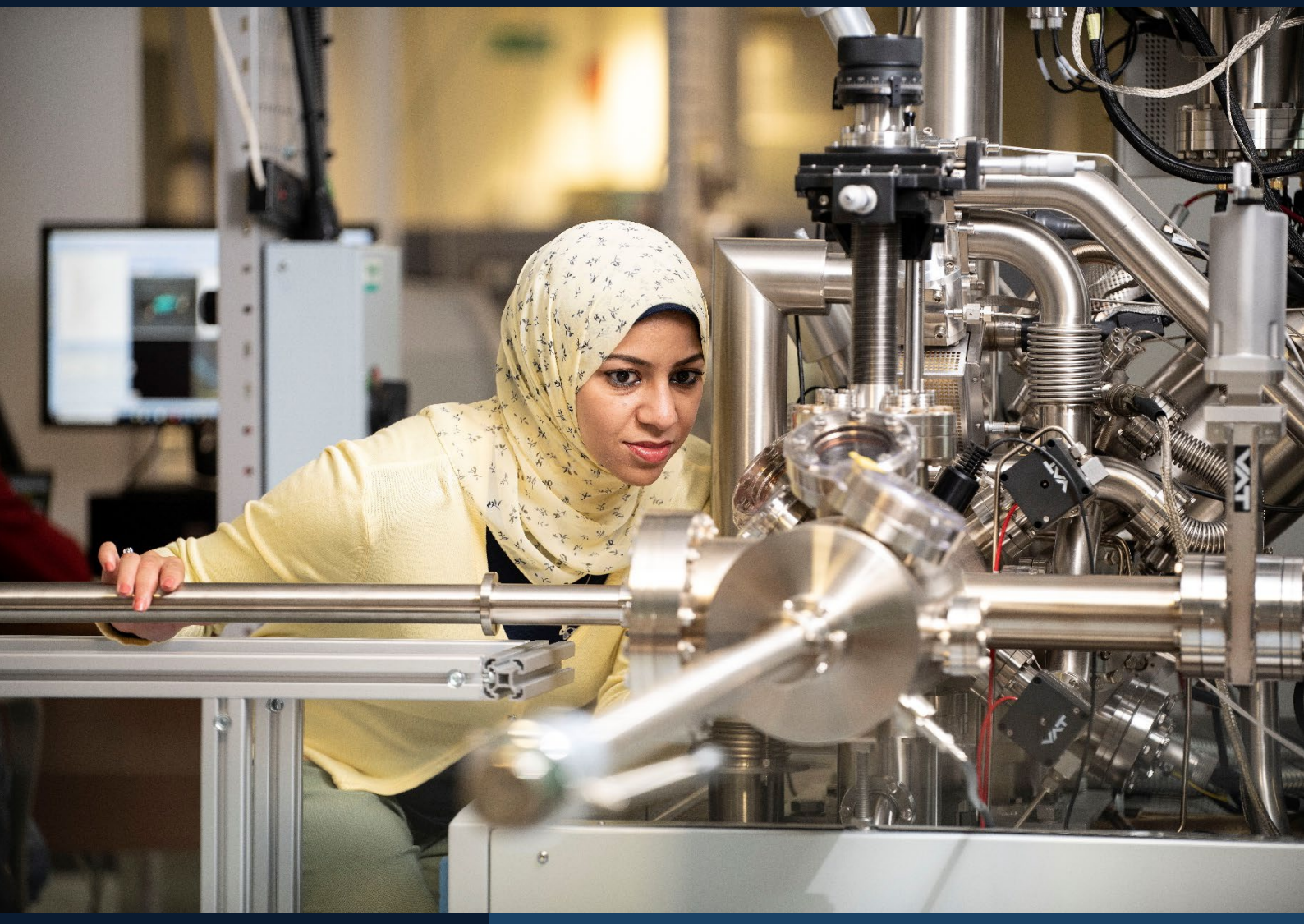
School of Engineering

Research and Innovation Annual Report

1 August 2024 - 31 July 2025



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1. FOREWORD

Research Director
Prof. John Anthony (Tony) Byrne

In presenting the Annual Report for Engineering for the academic year 2024-25, it is encouraging to report yet another extremely successful year for our research activities. Engineering Research involves a multi-disciplinary group of over 150 researchers. Our work is broadly conducted in 2 overarching themes relating to the Healthcare Technologies and Advanced Future Materials and Manufacturing (AFM2). Within these themes, and cross-cutting between themes, we have clusters of research in healthcare sensor systems, biomaterials and tissue engineering, environmental engineering, composites, advanced manufacturing, plasmas, and nanotechnology. We have a growing cluster in communications engineering. We aim to sustain our excellent performance in REF21 in which Engineering research at Ulster has continued to grow both in terms of scale and quality. We more than doubled the number of our staff submitted to REF since 2014 and our percentage of research deemed to be world-leading has more than tripled. Conducting impactful research, in line with the Sustainable Development Goals, has always been key to our strategy and we were recognised amongst the top tier of Universities delivering exclusively 3* and 4* research impact in engineering. We have strived to create an environment that supports all our researchers in their ambition to realise the highest quality research and are delighted to also have the entirety of our research environment recognised as 3*/4*. The school has a strong EDI ethos as evidenced by our Silver Athena Swan Award.

This was another successful year for Engineering Research contributing to research income of £19.5 million, 6 PhD Researcher graduations, and the publication of 97 journal articles in the reporting period. Of particular note is the recent award of a prestigious UK Research and Innovation (UKRI) Future Leaders Fellowship and a UKRI STFC grant to Dr Amir Farokh Payam. Also of note are further funding from MRC to Professor James Davis, two major PEACEPLUS grants (led by Professor James McLaughlin and Dr Adrian Boyd), a Place Based Impact accelerator funded by EPSRC and the Future Medicines Institute funded by Innovate UK, both led by Professor James McLaughlin.

Engineering research at Ulster aligns with two major funding developments for research within Engineering funded under the Belfast Region City Deals:

The £43M Centre for Digital Healthcare Technology (CDHT) led by Ulster will provide a world-class space for academia, industry, and clinicians to come together to innovate and boost the productivity of the Life and Health Sciences sector, as well as medical device and related sector activity in Northern Ireland. It will bring together internationally leading Computing-SERG (AI to IOT), Engineering-NIBEC (Digital Health Technology to diagnostic devices) and Biotechnology strengths (Molecular Diagnostics) from three Ulster schools leading to multidisciplinary research focused on many of the world's key challenges including rising healthcare costs and healthy ageing. Demolition

of the old Northland House is nearing completion with building of the new CDHT to begin soon. A landmark collaborative agreement between Ulster and the Belfast Health and Social Care Trust is in place to establish a Clinical Living Lab.

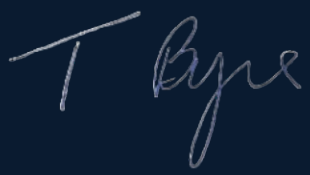
"We have strived to create an environment that supports all our researchers in their ambition to realise the highest quality research"

The £96M Advanced Manufacturing Innovation Centre (AMIC) is aimed at securing Northern Ireland's manufacturing future and will be a springboard for manufacturing innovation in Northern Ireland. AMIC will operate at the interface between academia and industry, by creating new opportunities for innovative manufacturing in the Belfast City Region. The involvement of both Queen's University Belfast and Ulster University will ensure that real-world industrial challenges based on market need are solved through cutting-edge research. AMIC builds on 50 years of sustained innovation and industry support through the Northern Ireland Technology Centre (NITC), the Polymers Processing Research Centre (PPRC) and the more recent university-industry partnership, NI Advanced Composites and Engineering (NIACE), and will consolidate and enhance these existing facilities.

Also of note was the recruitment of a further cohort of PhD researchers into the Centre for Doctoral Training in Digital Health Technologies. This is a collaboration between Ulster University & University College London with £11.7M funding from UKRI. Recruiting 75 researchers, the PhD programme will advance digital health technologies such as virtual hospital wards and hospital-at-home programmes that enable earlier diagnosis and personalised treatment strategies, alleviating pressure on the healthcare system.

We continue to enhance our research environment. Professor James McLaughlin was elected as a Fellow of the Royal Academy of Engineering and Professor Pilar Fernandez-Ibanez was appointed to the REF2029 Engineering Panel. We host the Engineering Seminar Series with lectures from visiting researchers, academic staff, research staff and PhD researchers. We have hosted visiting researchers from countries including China, India, Korea, Taiwan, and Brazil. We also actively engage in outreach and participate annually in the Northern Ireland Science Festival with Engineering Futures showcasing our research to primary school pupils and a number of other events.

Further details of our research, facilities, staff profiles and research expertise can be found at Engineering Research or by contacting **Charly Mifsud** (Academic Excellence Executive Assistant) at: **Email:** c.mifsud@ulster.ac.uk; **Tel:** +44 28 9536 7635.



Professor John Anthony (Tony) Byrne
Research Director, School of Engineering

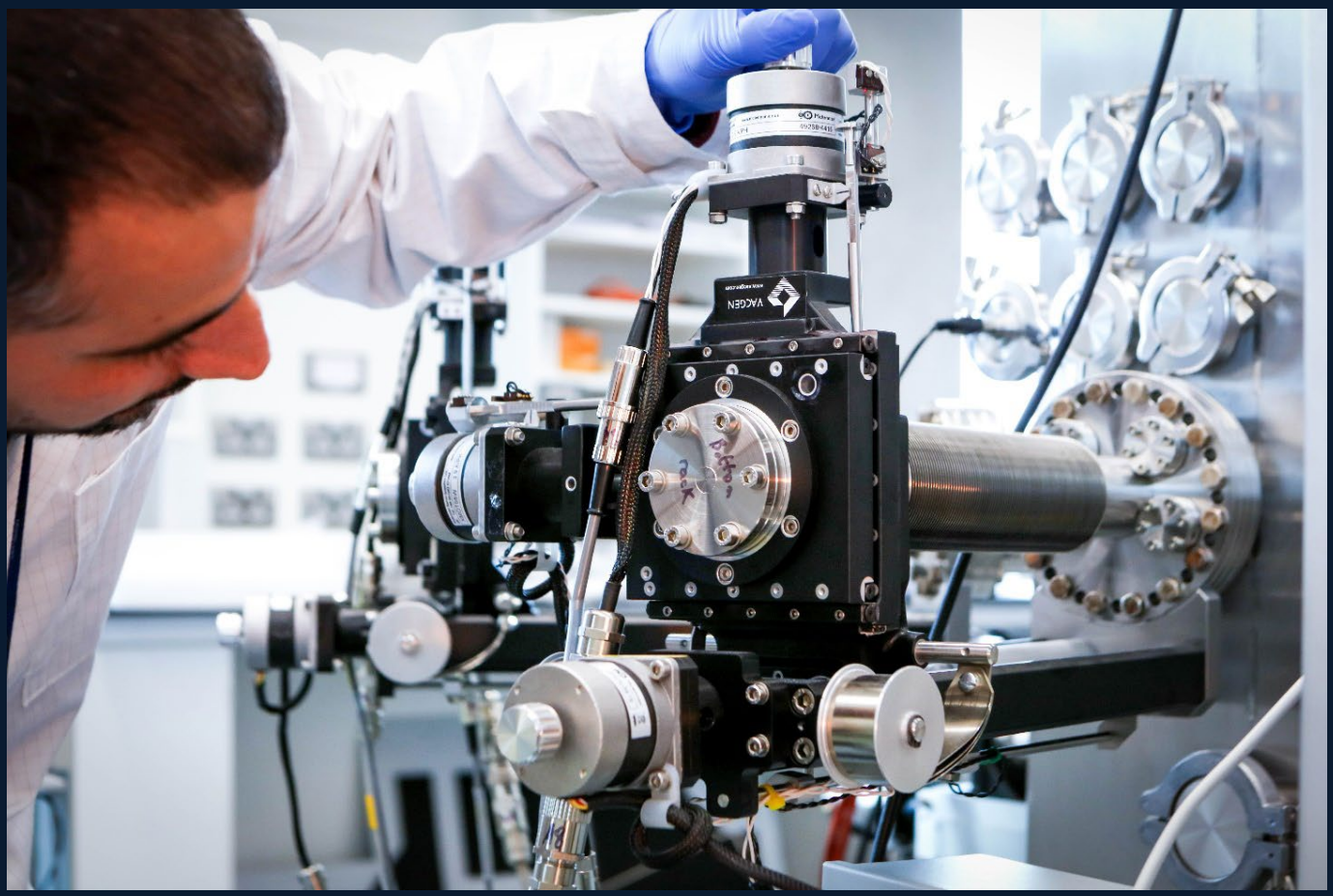
2. RESEARCH STUDENTS

NAME	PROJECT TITLE
Abdolalian, Saba	Photo-electro-bio-catalytic systems for wastewater treatment and resource recovery
Akram, Mahammad Shakeel	Cardio-AI-ReAccel: Reconfigurable Accelerators for Artificial Intelligence in Cardiology
Arshad, Waqas	Mapping and Analysis of Solid-Liquid Interfaces using 3D Scanning Force Microscopy
Bradley, Zoe	Enabling low-cost multiplexing for rapid point of care diagnosis of sepsis
Cairns, Zach	Strategies and methods for building sustainable medical devices by reduction of energy in hardware, software and offloaded processing
Chestnutt, Lisa	PhD Research Project
Clinton, Charlene	Meeting future global engineering challenges: Investigating how engineering skills and values can enable effective engagement with global responsibility and the UN Sustainable Development Goals
Daha, Muhammad Yunis	Edge Intelligence for 5G Networks and Beyond
Doggart, Peter	Artificial Intelligence Enhanced Electrocardiography in Emergency Departments
Gilpin, Victoria	Design of wearable electrochemical sensor systems for monitoring the well-being of ostomy patients
Hasson, Frances	3D printed Polymer/ Bioceramic Composites for Medical Devices
Henderson, Isla	PhD Research Project
Islam, Kd M Raziul	Microwave Metasurfaces for Polarisation Conversion and Absorption Applications
Jacob, Jenson	A study into how evidence based digital health technologies and usage of health data can transform pathways and outcomes

Kashyap, Apoorva	Measuring DNA damage created by a gaseous flux of hydroxyl radicals and plasma-activated microdroplets delivered from a remote plasma operating at atmospheric pressure
Keegan, Elaine	How digital health can tackle challenges faced by the healthcare system and how advancing monitoring technologies can be the future of healthcare
Khalid, Hafiz Usman	Prevention of biofouling of polymer composites for application in the marine environment
Khalid, Hifza	Prevention of biofouling of polymer composites for application in the marine environment
Khalid, Wajahat	Novel metal-organic frameworks and their functional derivatives for affordable clean energy generation
Kielt, Sean	High Precision Printing of Biomimetic Structures for Tissue Regeneration
King, Phoebe	Resorbable Biomaterials for Next-Generation Orthopaedics
Kinneen, Rose	Functionalised 3D printed open cell structures for tissue scaffold applications
Kirch, Brian	Implementing Mechatronic Control and Analysis of Carbon Fibre Weaving
Lawson, James	Strengthening of 3D-printed parts using Advanced Manufacturing techniques
Lionadi, Indrianita	Visualization, characterization and treatment of cancer cells using nanoparticles
McArthur, Chloe	Development of Multifunctional Composite Coatings for Magnesium-based Resorbable Implants
McCallion, Arian	Resorbable Biomaterials for Next-Generation Orthopaedics
McCartney, Ben	An investigation into paediatric out of hospital cardiac arrest and resuscitation; role and optimisation of PADs
McCausland, Christopher	Automatic detection of sleep arousals using deep learning and a visual representation of time-frequency analysis of EEG signals
McCollum, Aaron	Transformative Applications of Quantum Machine Learning in Digital Healthcare

McCrickard, Conor	Dimensional stability of 3D printed medical devices
McGreeghan, Aine	Understanding the influences on the self-efficacy of female engineering students in Northern Ireland.
McIlhatton, Ellamay	Coatings for Resorbable Magnesium Orthopaedic Implants
McMath, Regan	Microneedle Array Patch for the continuous monitoring of diabetes in interstitial biofluid
McMullan, Reshma	Studying the 3D printing on PEKK with respect to different grades and suppliers
Montgomery, Callum	Advancing composite preforming technologies for complex loaded maritime structures
Muldoon, Kirsty	High Precision 3D Printing for Novel Biomedical Applications
Mulhern, Brianna	Uncovering the biomechanical mechanisms of concussion in professional rugby league
Nasr, Sara	Advanced techniques for detection and removal of biofilm in marine vessels using electric sensors
New, Sarah	Novel multilayer porous structures with controllable nanoscale interactions for biomedical applications
O'Boyle, Adam	Development of an autonomous tufting machine for carbon laminate reinforcement
O'Donnell, Eimear	3D printing for manufacturing medical devices
Pestano, Zamir	Air-Dis Development of novel air disinfection systems
Power, Abigail	Additive Manufacturing using Advanced Robotics and Arc Metal Welding
Rooney, Karyn	Analysis of Materials, Processes and Design of Continuous Multilayer Composite Pipe
Rose, Cara	Enhanced Obstacle Avoidance System for Parcelcopters in Dynamic Environments
Sokol-Randell, Darek	Understanding the risks, mechanism and severity of football heading through biomechanical modelling

Spence, Cody	Development of advanced preforming technologies for use in complex marine structures
Woodward, James	The Biomechanical Mechanisms of Mild Traumatic Brain Injuries in Women's Rugby Union
Wucherer, Stefanie	Developing a hybrid model and supervised learning approach for automated handling tasks using tactile feedback

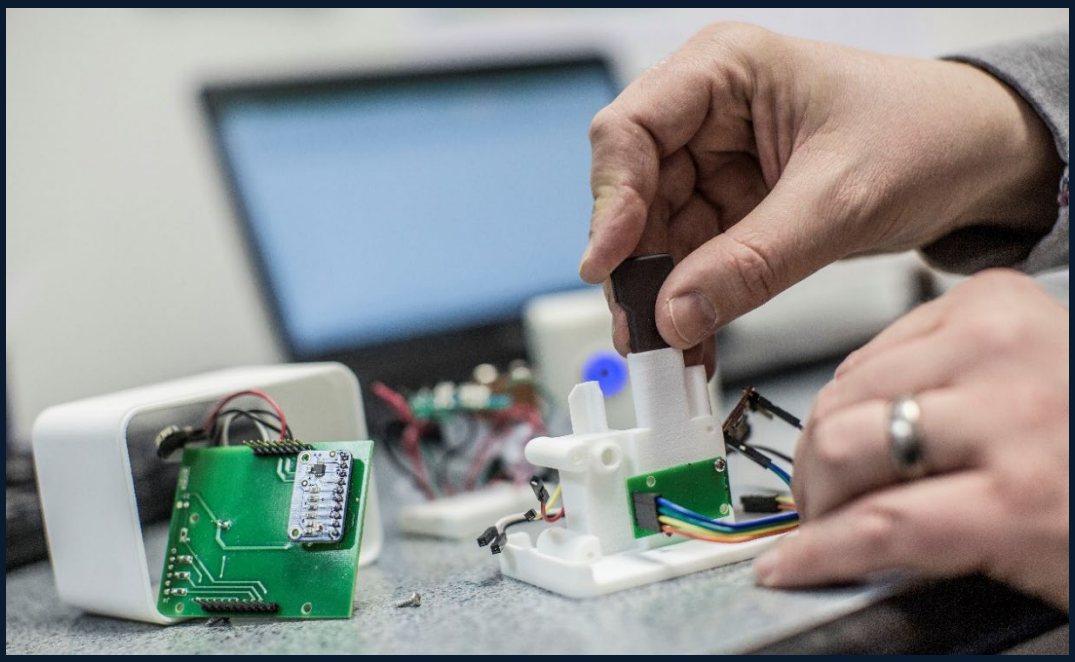


GRADUATED DEC 2024

NAME	PROJECT TITLE
Fairooz, Towfeeq	Enhancing Lateral Flow Assay Analysis Through the Integration of Artificial Intelligence and Image Processing
Scott, Cameron	Laser-Induced Graphene: Novel Approaches for Sensing and Drug Delivery Applications

GRADUATED JULY 2025

NAME	PROJECT TITLE
Gallagher, Courtney Margaret	Morphology Characterisation of Additive Manufacturing Powder Through Automated Image Analysis Algorithms
Khalil, Sameh	Novel Nanostructures for High Efficiency Solar Energy Harvesting
McLarnon, Liam	Development of Fibrous Ophthalmic Biomaterial Scaffolds for Wound Healing and Ophthalmic Tissue Engineering
Stinson, Harley	Wire Arc Additive Manufacturing of Thin-Walled Stiffening Structures



3. RESEARCH OUTPUTS

This section reports those outputs published and/or delivered over the period of this report and classified as either: journal articles, books/chapters in books, research reports, published conference papers, or live conference contributions. https://pure.ulster.ac.uk/.

3.1. JOURNAL ARTICLES

Abbasi, MR, Ghannad, M & Nasrekani, FM 2025, 'Analytical solution for buckling analysis of FGM axisymmetric cylindrical shell under axial load using shear deformation theory and perturbation technique', Iranian Journal of Mechanical Engineering Transactions of the ISME. https://doi.org/10.30506/jmee.2025.2058190.1373

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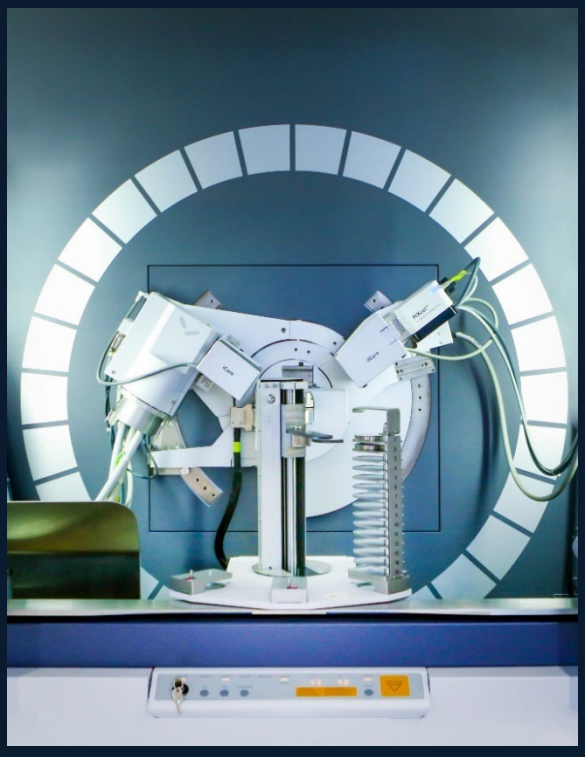
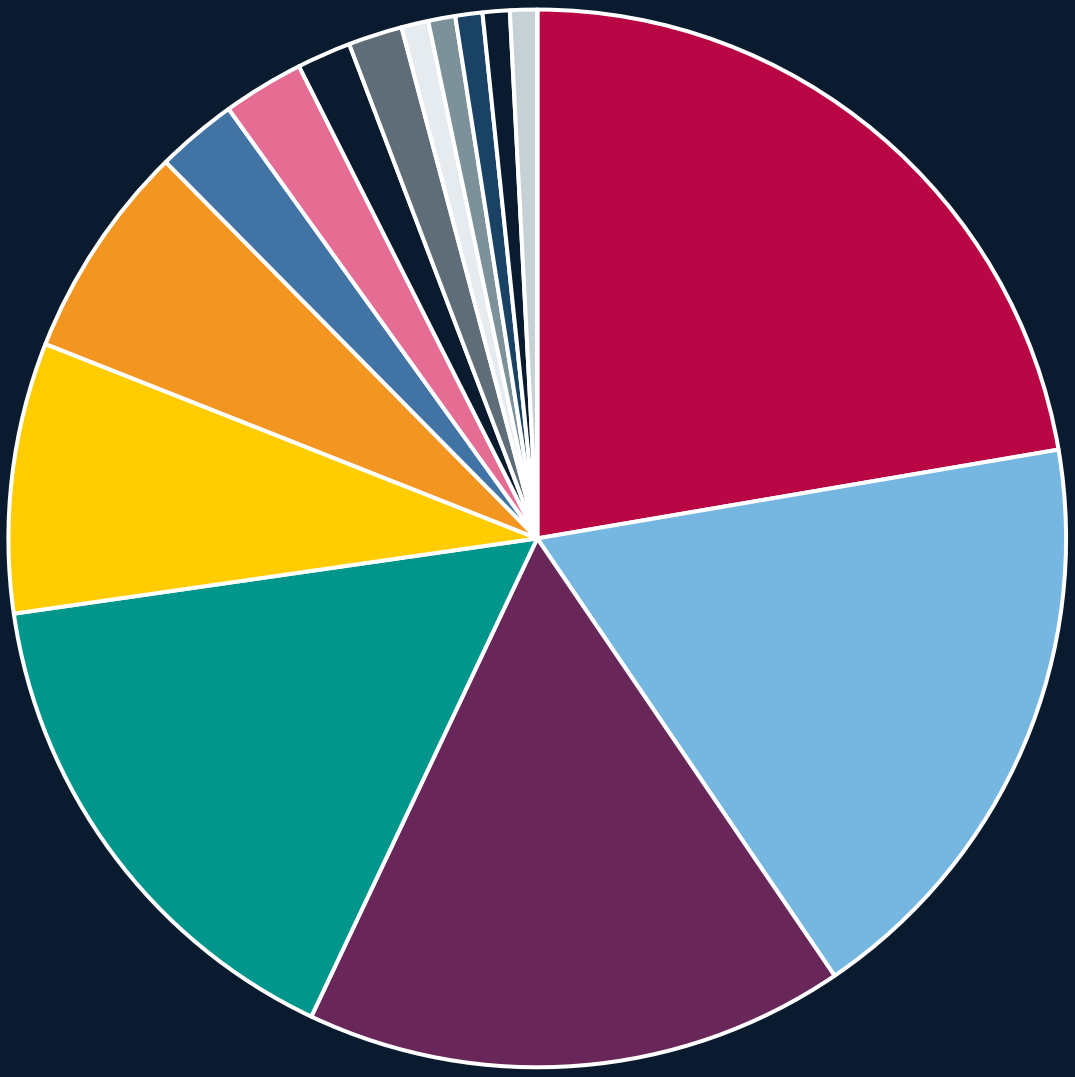


SUSTAINABLE DEVELOPMENT GOALS

Universities and knowledge institutions have a critical role to play in the achievement of the United Nations Sustainable Development Goals (SDGs). Here is a breakdown of the Research Outputs for the School of Engineering, according to their SDGs.



- SDG 9 - Industry, Innovation, and Infrastructure
- SDG 11 - Sustainable Cities and Communities
- SDG 13 - Climate Action
- SDG 6 - Clean Water and Sanitation
- SDG 10 - Reduced Inequalities
- SDG 1 - No Poverty
- SDG 4 - Quality Education
- SDG 15 - Life on Land
- SDG 3 - Good Health and Well-being
- SDG 7 - Affordable and Clean Energy
- SDG 12 - Responsible Consumption and Production
- SDG 8 - Decent Work and Economic Growth
- SDG 17 - Partnerships for the Goals
- SDG 2 - Zero Hunger
- SDG 14 - Life Below Water

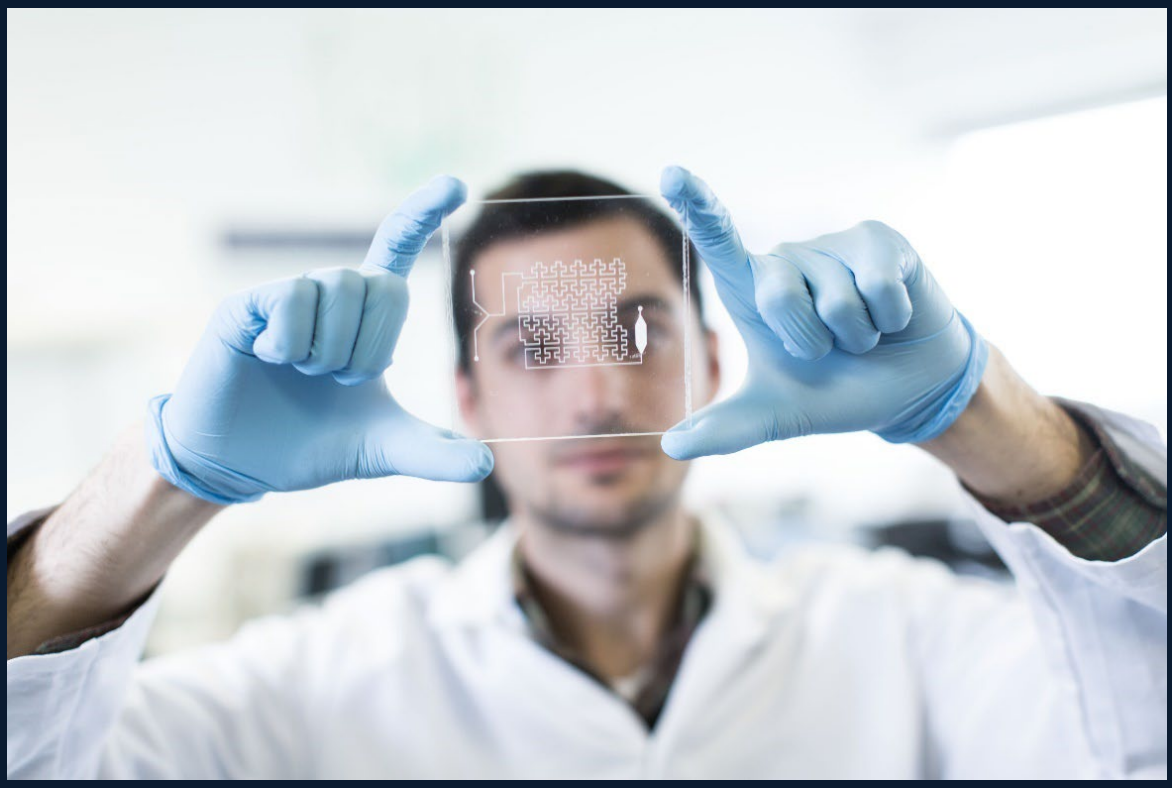
4. RESEARCH FUNDING

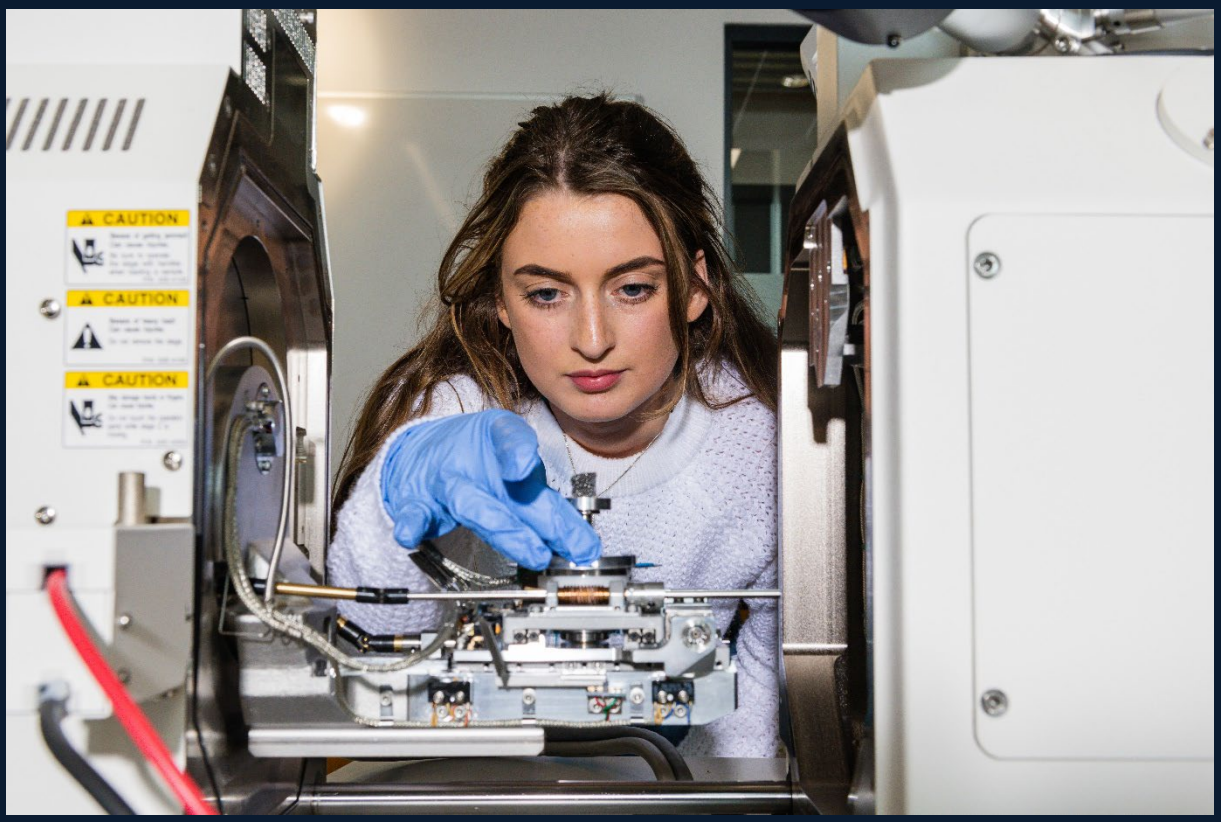
Portfolio of Research Grants awarded during period 1 August 2024 - 31 July 2025

UoA MEMBER(S)	PROJECT TITLE	FUNDER	VALUE	AWARD DATE
Paul Sargent Adrian Boyd Pagona Papakonstantinou	Circular Economy-friendly concRetes using munIcipal waste, calciNed clays and graphenE for Floating Offshore Wind applications	Institution of Civil Engineers	£35,166.30	29 Aug 2024
Nikhil Bhalla	Futures AMR Network	Biotechnology & Biological Sciences Research Council (BBSRC)	£27,670.00	2 Sep 2024
Harold McQuaid	BreathSpark - Collaboration HH Kickstarter	Health~Holland	£40,459.72	14 Oct 2024
Omar Escalona Dewar Finlay James McLaughlin	Armband Continuous Cardiac Output and Rhythm Diagnostics (ACCORD) Device Customer Discovery	Invest Northern Ireland	£14,900.00	4 Nov 2024
Muhammad Usman Hadi	TNE Exploratory Grants: Drones-based climate resilience - A expertise exchange between Ulster and MUET	British Council	£20,049.49	18 Nov 2024
Bryan Scotney Paul Beaney James McLaughlin	BTIIC Phase 2 - BT Direct Funding	BT Group	£4,800,000.00	27 Nov 2024
James McLaughlin Dewar Finlay Brian Meenan	STREAM 1. Digital Healthcare Technology Impact Accelerator - DHTA- PBIAA 2	Engineering & Physical Sciences Research Council (EPSRC)	£2,552,948.00	7 Feb 2025

James McLaughlin Paul Beaney Ann Blair	GREBT Pilot	Belfast City Council	£15,000.00	12 Feb 2025
James McLaughlin	Future Medicines Institute	Innovate UK	£3,188,359.00	18 Feb 2025
John (Tony) Byrne Antonia (Pilar) Fernandez-Ibanez	Multifunctional self-powered nano-based-unit for water pollutants filtration and monitoring	Qatar National Research Fund	£32,535.28	10 Mar 2025
Nikhil Bhalla	Optical Fiber Sensing Platform for PFAS Detection and Aqueous Quality Evaluation (OPAQUE)	The British Academy	£10,000.00	21 Mar 2025
Muhammad Usman Hadi Dewar Finlay Alistair McIlhagger Sharatchandra Varma Bogaraju	IoT-Driven Cybersecurity Framework for Intrusion Detection in the Internet of Drones	Innovate UK	£31,544.54	26 Mar 2025
Saikat Jana Patrick Dunlop	Pathogen Transport and Distribution - IES\R3\243002	The Royal Society	£12,000.00	28 Mar 2025
Amir Farokh Payam	Design and Fabrication of Quantum NV-hBN Drum Resonators for Advanced Sensing Applications	Science and Technologies Facilities Council (STFC)	£256,884.28	1 Apr 2025
James Davis	Addressing GAPS in Stoma Output Monitoring	Medical Research Council (MRC)	£173,610.96	2 Apr 2025
James Davis	STOMACAP: Reimagining Stoma Management	Invest Northern Ireland	£231,203.00	15 May 2025
Adrian Boyd Edward Archer Atefeh Golbang Alistair McIlhagger Krzysztof Rodzen	NWCAM2	EU Programme for Peace and Reconciliation in Northern Ireland and the Border Region of Ireland (PEACEPLUS)	£2,157,156.90	24 Jul 2025

James McLaughlin Ann Blair Dewar Finlay	HEALTH FRONTIERS-Technology Innovation Centre	EU Programme for Peace and Reconciliation in Northern Ireland and the Border Region of Ireland (PEACEPLUS)	£3,244,788.06	25 Jul 2025





5. NOTE FROM THE ASSOCIATE DEAN

The 2024-25 Annual Research Report for the School of Engineering reflects the continued commitment of Ulster University to deliver impactful research excellence in areas that actively contribute to the economy of Northern Ireland and to society more generally.

The scope and scale of the research undertaken by colleagues in the School is reflected in the high quality outputs reported here. The positive impact this research it is having on society is evident in the attainment of competitive grant income; PhD graduations; partnerships with industry and in collaborations with other national and international research institutions. Importantly, the new contributions to knowledge that have been made span the full range of United Nations Sustainable Development Goals (SDGs).

The University Strategy: 'People, Place and Partnership' seeks to deliver 'Sustainable Futures for All' with research and innovation central to its success. The associated University Research Strategy (2023-2028) focuses on how our core values of Collaboration, Enhancing Potential, Inclusion and Integrity underpin a sector leading enviroment for the continued development of talent and opportunity across our designated research themes.

"As we move closer to [REF2029], we are focussed on further increasing our world-leading and internationally excellent research"

As we move closer to the 2029 UK Research Excellence Framework exercise (REF2029), we are focussed on further increasing our world-leading and internationally excellent research across relevant Units of Assessment in a way that impacts both locally and globally with the ethos of Open Research at its core.

Professor Brian J. Meenan
Associate Dean for Research and Innovation

REF 2021

Research Centres and Groups

Advanced Future Materials and Manufacturing **(AFM2)**

Nanotechnology and Integrated Bioengineering Centre **(NIBEC)**

Ulster University

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