

FREDERICK UNIVERSITY
Department of Mechanical Engineering

Proposed PhD Research Topics
Academic Year 2026–2027

Prepared by:
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List of PhD Topics

1. Electric Vehicle Crashworthiness	3
2. Design of Smart Road Restraint Systems.....	3
3. Hydrogen Energy Systems.....	3
4. Energy–Water–Transport Nexus	3
5. Renewable and Sustainable Power Systems	3
6. Sustainable Energy Policy.....	3
7. Energy Communities and Decentralized Systems.....	4
8. Electricity Interconnections and Cross-Border Systems.....	4
9. Advanced Hydrogen Compression and Storage using Metal Hydride Systems.....	4
10. Design, Optimisation and Safety Assessment of Hydrogen Refuelling Stations	4
11. Grid-Scale Battery Energy Storage Systems for High Renewable Penetration Power Systems.....	4
12. Food–Energy–Water Nexus in Cyprus.....	5
13. Circular Systems in Sustainable Aquaculture	5
14. Digital Tools for Blue Economy.....	5
15. 3D Printing and Manufacturing for Medical Applications	5
16. Automation and Motion Systems in Medical Applications.....	5
17. Environmental Radioactivity and Monitoring for Civil Protection	5
18. Data Analysis and Modelling for Nuclear Science	6
19. Computational Medical Imaging and Tomographic Reconstruction.....	6
20. Optimization of Fiber Laser Cutting Processes for Enhanced Precision and Reduced Material Waste	6
21. Modelling and Optimisation of Process-Structure Interaction in Additive Manufacturing for the Creation of High Quality Products	6
22. Digital Analysis and Reconstruction of Road Traffic Accidents.....	6
23. Design and Additive Manufacturing of Composite Materials for Lightweight Applications	7
24. Sustainability Assessment of the Built Environment	7
25. Experimental and Numerical Thermofluids Applied to the Built Environment.....	7
26. Ammonia atomization modelling and CFD simulations for zero-carbon internal combustion engines.....	7
27. From atomistic to macroscale modelling and simulation of electrochemical fluid/structure for carbon dioxide reduction.....	7

1. A numerical investigation of occupant safety during vehicle impacts with w-beam guardrail systems

Supervisor: Prof. George Demosthenous
Research area / keywords: Occupant safety, ASI, THIV, occupant risk criteria, W-beam guardrail, finite element analysis, crash simulation, EN1317
Short description: This research employs computational simulations to investigate occupant safety during impacts between vehicles and W-beam guardrail systems, with particular focus on occupant acceleration profiles and established injury risk indices like ASI and THIV.

2. Computational investigation of the sensitivity of guardrail crashworthiness to key structural and geotechnical parameters during impacts with contemporary vehicles.

Supervisor: Prof. George Demosthenous
Research area / keywords: Crashworthiness, guardrail, W-beam, roadside restraint systems, structural analysis, sensitivity analysis, post spacing, embedment depth, finite element analysis, LS-DYNA, computational simulation, design optimization
Short description: This research conducts a systematic study using computational simulations to quantify the sensitivity of key guardrail performance metrics to post spacing, blockout geometry and material, steel post cross section and wall thickness, and the mechanical properties of the surrounding soil medium, across impact scenarios involving contemporary vehicles.

3. Hydrogen Energy Systems

Supervisor: Prof. Andreas Poullikkas
Research area / keywords: Hydrogen, energy systems, renewable integration, fuel cells, optimization
Short description: This topic focuses on modelling and feasibility analysis for hydrogen production, storage, transport, and use in sustainable energy systems. It examines hydrogen as a means of renewable energy integration, including green hydrogen pathways, fuel cell applications, and supply chain optimisation for decarbonisation.

4. Energy–Water–Transport Nexus

Supervisor: Prof. Andreas Poullikkas
Research area / keywords: Nexus modelling, resource management, sustainability, techno-economic optimisation
Short description: This topic focuses on developing integrated modelling and optimisation frameworks for the interactions between energy systems, water resources, and transport infrastructure. The work examines synergies and trade-offs in resource allocation and supports policy-oriented analysis for sustainable development pathways.

5. Renewable and Sustainable Power Systems

Supervisor: Prof. Andreas Poullikkas
Research area / keywords: Renewable power systems, power system analysis, optimisation, electricity and transport sectors
Short description: This topic focuses on optimisation methodologies for highly renewable power systems, including the interaction between electricity and transport. The aim is to develop analysis tools and optimise system performance in terms of both efficiency and cost.

6. Sustainable Energy Policy

Supervisor: Prof. Andreas Poullikkas

Research area / keywords: Energy policy, energy system analysis, sustainability, scenario modelling

Short description: This topic focuses on developing tools and models to assess the economic and social dimensions of energy technologies and support short-, medium-, and long-term energy planning. The research emphasizes whole-system analysis and simulation of flexible sustainable energy systems.

7. Energy Communities and Decentralized Systems

Supervisor: Prof. Andreas Poullikkas

Research area / keywords: Energy communities, decentralised systems, prosumers, local energy markets

Short description: This topic focuses on frameworks and models for the planning and optimisation of decentralised energy communities, including renewable cooperatives, prosumer networks, and local markets. It addresses governance, business models, regulation, and technical integration of distributed resources.

8. Electricity Interconnections and Cross-Border Systems

Supervisor: Prof. Andreas Poullikkas

Research area / keywords: Electricity interconnections, cross-border trade, grid reliability, renewable integration

Short description: This topic focuses on developing optimisation models and feasibility studies for interconnections between regional power systems. It focuses on capacity optimisation, bidirectional flows, market coupling, and operational strategies for integrating isolated or weakly connected systems.

9. Advanced Hydrogen Compression and Storage using Metal Hydride Systems

Supervisor: Prof. George Karagiorgis

Research area / keywords: Hydrogen storage, hydrogen compression, metal hydrides, thermodynamic modelling

Short description: This topic examines the development and validation of innovative metal hydride materials and hydrogen compression systems. The research combines thermodynamic modelling, system design, and performance optimisation to support efficient and lower-cost hydrogen storage solutions.

10. Design, Optimisation and Safety Assessment of Hydrogen Refuelling Stations

Supervisor: Prof. George Karagiorgis

Research area / keywords: Hydrogen infrastructure, refuelling stations, process design, safety engineering

Short description: This topic focuses on the integrated design, optimisation, and safety assessment of hydrogen refuelling stations for urban and highway use. It addresses compression, storage, fast-filling thermal effects, operational strategies, and risk analysis under variable demand conditions.

11. Grid-Scale Battery Energy Storage Systems for High Renewable Penetration Power Systems

Supervisor: Prof. George Karagiorgis

Research area / keywords: Battery storage, power systems, electricity markets, renewable integration

Short description: This topic investigates the design, operation, and market participation of grid-scale battery energy storage systems in systems with high renewable penetration. It

emphasizes flexibility services, degradation modelling, investment optimisation, and the role of storage in supporting grid stability.

12. Food–Energy–Water Nexus in Cyprus

Supervisor: Assoc. Prof. Michalis Menicou

Research area / keywords: FEW nexus, resource management, modelling, optimisation, sustainability

Short description: This topic addresses integrated modelling and optimisation frameworks for the sustainable management of food production, energy supply, and water resources in Cyprus. It focuses on interdependencies, resource efficiency, resilience, and decision-support for regional and national planning.

13. Circular Systems in Sustainable Aquaculture

Supervisor: Assoc. Prof. Michalis Menicou

Research area / keywords: Circular economy, aquaculture, fisheries, techno-economic assessment, sustainability

Short description: This topic investigates circular production systems in aquaculture and fisheries, with emphasis on efficient use and valorisation of residues and by-products. The research develops sustainability and techno-economic models to support low-waste and resource-efficient blue bioeconomy systems.

14. Digital Tools for Blue Economy

Supervisor: Assoc. Prof. Michalis Menicou

Research area / keywords: Blue economy, decision-support tools, sustainability assessment, digital engineering

Short description: This topic focuses on software-based decision-support tools for planning, monitoring, and evaluating sustainability and innovation projects in coastal and marine environments. It integrates techno-economic analysis, environmental impact assessment, and risk evaluation into practical digital tools for stakeholders and policymakers.

15. 3D Printing and Manufacturing for Medical Applications

Supervisor: Prof. Yiannis Parpottas

Research area / keywords: 3D printing, medical manufacturing, medical devices, healthcare engineering

Short description: This topic explores 3D printing, materials, and manufacturing methods for medical and healthcare applications. It includes the design and development of devices, models, and other solutions that can improve diagnosis, treatment, training, and patient care.

16. Automation and Motion Systems in Medical Applications

Supervisor: Prof. Yiannis Parpottas

Research area / keywords: Automation, motion systems, medical applications, control, medical devices

Short description: This topic focuses on automation, control, and programmable motion technologies for medical applications. It supports research into next-generation systems for healthcare, diagnostics, research, and medical device development.

17. Environmental Radioactivity and Monitoring for Civil Protection

Supervisor: Prof. Yiannis Parpottas

Research area / keywords: Environmental radioactivity, radiation monitoring, civil protection, emergency preparedness

Short description: This topic addresses environmental radioactivity, radiation measurement, and monitoring systems relevant to public safety and resilience. The research supports civil protection, emergency preparedness, and evidence-based environmental assessment.

18. Data Analysis and Modelling for Nuclear Science

Supervisor: Prof. Yiannis Parpottas

Research area / keywords: Nuclear science, experimental data analysis, modelling, computational methods

Short description: This topic focuses on experimental data analysis in nuclear science using real datasets and advanced analysis methods. It offers opportunities for internationally connected research activity and modelling work in collaboration with nuclear research infrastructures.

19. Computational Medical Imaging and Tomographic Reconstruction

Supervisor: Assoc. Prof. Theodoros Leontiou

Research area / keywords: Medical imaging, tomographic reconstruction, inverse problems, machine learning

Short description: This topic focuses on advanced computational methods for medical imaging, especially tomographic reconstruction such as SPECT and PET, inverse problems, and data-driven modelling. The research involves physics-based modelling, optimisation, and machine learning for personalised and clinically relevant imaging applications.

20. Optimization of Fiber Laser Cutting Processes for Enhanced Precision and Reduced Material Waste

Supervisor: Prof. Antonis Lontos

Research area / keywords: Advanced manufacturing, fiber laser cutting, process optimisation, sustainable manufacturing

Short description: This topic investigates how fiber laser cutting parameters such as power, cutting speed, assist gas, and focal position affect cut quality and material waste. The aim is to develop optimised cutting strategies and predictive models that improve precision, efficiency, and manufacturing sustainability.

21. Modelling and Optimisation of Process-Structure Interaction in Additive Manufacturing for the Creation of High Quality Products

Supervisor: Assoc. Prof. Loucas Papadakis

Research area / keywords: Additive manufacturing, process optimisation, product and process design

Short description: This topic focuses on modelling the interaction between manufacturing process parameters and structural performance in additive manufacturing. The aim is to improve product quality through process design, optimisation, and simulation-based analysis.

22. Digital Analysis and Reconstruction of Road Traffic Accidents

Supervisor: Assoc. Prof. Loucas Papadakis

Research area / keywords: Road safety, accident reconstruction, digital analysis, vehicle safety

Short description: This topic focuses on digital methods for the analysis and reconstruction of road traffic accidents. The research is expected to support improved understanding of accident mechanisms and contribute to vehicle and road safety studies.

23. Design and Additive Manufacturing of Composite Materials for Lightweight Applications

Supervisor: Assoc. Prof. Loucas Papadakis
Research area / keywords: Composite materials, additive manufacturing, lightweight structures, product design
Short description: This topic examines the design and additive manufacturing of composite materials for lightweight engineering applications. It is expected to focus on material-structure design and manufacturing approaches that improve performance while reducing weight.

24. Sustainability Assessment of the Built Environment

Supervisor: Prof. Paris Fokaides
Research area / keywords: Sustainable buildings, life cycle assessment, environmental performance, renovation, certification schemes
Short description: This topic focuses on the assessment of the sustainability performance of buildings and renovation strategies using environmental, economic, and multi-criteria evaluation approaches. The research may involve life cycle assessment, sustainability indicators, and the development or application of tools that support evidence-based decision-making for a more sustainable built environment.

25. Experimental and Numerical Thermofluids Applied to the Built Environment

Supervisor: Prof. Paris Fokaides
Research area / keywords: Thermofluids, heat transfer, airflow, building physics, indoor environment, numerical modelling
Short description: This topic examines heat and fluid flow phenomena in buildings through a combination of experimental measurements and numerical modelling. The research may address ventilation, thermal comfort, heat transfer, and energy performance, with the aim of improving the design and operation of buildings and their technical systems.

26. Ammonia atomization modelling and CFD simulations for zero-carbon internal combustion engines

Supervisor: Assoc. Prof. Charalambos Chasos
Research area / keywords: Thermofluids, internal combustion engines, Computational Fluid Dynamics (CFD)
Short description: This topic examines the atomization and transcritical ammonia flow and evaporation/boiling phenomena in direct-injection fuel systems for automotive and marine internal combustion engines. There is limited data and predictive atomization models for ammonia injection and it poses a great challenge to apply design and modelling approaches for optimized volume-of-fluid (VOF) CFD modelling and simulations capable of capturing the transcritical effects of ammonia behavior on atomization and spray characteristics.

27. From atomistic to macroscale modelling and simulation of electrochemical fluid/structure for carbon dioxide reduction

Supervisor: Assoc. Prof. Charalambos Chasos
Research area / keywords: Thermofluids, internal combustion engines, Computational Fluid Dynamics (CFD), electrocatalysts
Short description: This topic examines carbon dioxide (CO ₂) reduction methods and addresses the macroscale modelling for inclusion in finite-volume-method computational fluid dynamics (CFD) simulation framework. It is envisaged to simulate the phenomena of

chemical reactions and transport of species at a membrane-electrode-assembly electrochemical cell for CO₂ reduction aimed to contribute in advanced biofuels production.

Doctoral Program Director: Professor Paris Fokaides,
Email: p.fokaides@frederick.ac.cy

Deadline for submission of applications: Monday 14th September 2027

Admissions Requirements

Eligible applicants must hold a Bachelor's degree in Mechanical Engineering or in a related field, such as Energy Engineering, Materials Engineering, Manufacturing Engineering, Chemical Engineering, Physics, Applied Mathematics, Control Systems, or other relevant scientific and engineering disciplines, obtained from an institution recognized in the country where it operates. A Master's degree relevant to the proposed research area of the PhD studies is also required. Applicants who do not hold a directly relevant Master's degree may also be considered under special circumstances.

The PhD Programme is based on the European Credit Transfer and Accumulation System (ECTS). The award of the PhD degree requires the successful completion of **180 ECTS**. In cases where admitted candidates do not hold a Master's degree, they will be required to follow an extended study plan amounting to a total of **240 ECTS**.

All candidates must have a very good knowledge of the English language.

For more information visit the University's [website](#)

Applications

Each application for admission must include:

- **A completed [Application Form](#), available online.**
- **An up-to-date Curriculum Vitae.**
- **A Personal Statement (1-2 pages)**, outlining the candidate's professional and research interests and future plans, their suitability to the PhD program and the reasons for applying.
- **A Preliminary Research Proposal (approximately 1500 words)**, briefly describing the proposed area in which the candidate is interested in conducting research.
- **Certified copies of all relevant Degrees and Transcripts.**
- **Copies of any other supporting material, such as exams, awards, etc.**
- **Two (2) Letters of Recommendation**, at least one from an academic referee
- **Proof of English Language proficiency**, such as TOEFL, IELTS, IGCSE, Cambridge Certificate of Proficiency in English or any other equivalent language examination. Candidates who have completed an undergraduate or graduate program where the language of instruction was English satisfy the proof of English language proficiency requirement.
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All application material must be submitted in English.

Candidates who meet all the admissions criteria may be invited for an interview.

Tuition Fees

Tuition fees are published on the Frederick University [website](#). Applicants may be eligible to apply for tuition scholarships of up to 90%, subject to conditions and upon approval of their application.

For more **information**, please contact:

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