ID	Project First Supervisor	Project Title	Project Description	Consumables required	Students	Reading List
1	Sajjad Hussain	LLM Powered Personalised Learning	The student(s) are expected to explore the space around LLM-powered personalized learning methods and models. The focus of this project will be on creating the differentiation between general LLM and tailored LLM solutions as per the needs of the learners.	Software subscriptions.	1-2	1) https://arxiv.org/abs/2405.11070 2) https://ieeexplore.ieee.org/document/10628100
2	Atif Jafri	Exploring the of IGLOO 2 FPGAs for low power DDS Implementation	IGLOO2 are power efficient FPGAs offered by Microchip. In this project, the students will develop low power Direct Digital Synthesis (DDS) circuits and evaluate different architecture of DDS for hardware used, clock speed and power utilization. They will learn the Libero SoC Design Suite which is development environment for these FPGAs.	IGLOO2 Evaluation Kit	2	https://www.microchip.com/en-us/development-tool/m2gl-eval-kit
3	Atif Jafri	Vitis AI for AI Inference Implementation on Ultrascale+ MPSoC	Vitis AI is framework by AMD to implement inference of AI applications on FPGA using DPU soft core. In this project students will learn this design flow to implement AI inference of vision applications on FPGA. They will have the have on experience on using the Kria KC260 vision kit.	Kria KV260 Vision AI Starter Kit	2	https://xilinx.github.io/Vitis-AI/3.5/html/docs/reference/release_documentation.html https://docs.amd.com/r/en-US/pg338-dpu?tocId=3xsG16y_QFTWvAJKHbisEw

4	Atif Jafri	Communication System Implementation on RFSoC	RFSoC are multiprocessor platforms with FPGA fabric and RF ADC/DACs. In this project, the students will learn to develop components of digital communication system on FPGA. They will also learn how these components can be controlled through processing systems of RFSoC using PYNQ framework.	RFSoC 4x2 Board	2	https://www.rfsoc-pynq.io/ https://pynq.readthedocs.io/en/v2.0/overlay_design_methodology/overlay_tutorial.html
5	Yihuai Zhang	Design and develop the novel microwave tools for rock fracturing	Rock fracturing is a critical process in various engineering fields, traditionally achieved through explosives or mechanical drills. Recent research suggests that microwaves can be used to heat rock, inducing thermal stress and micro-cracking, which facilitates easier breakage. This project will combine both experimental and computational methods to: 1, develop design concepts for a microwave tool optimised for rock fracturing. This phase will involve creating prototypes—potentially using computer-aided design (CAD) software—and considering factors such as microwave frequency, power output, and tool geometry to maximise efficiency and safety. 2. Make and test the prototypes on rock samples under controlled laboratory conditions. Measurements will include temperature profiles, fracture patterns, and energy consumption. Data from these	microwave generator, electrical consumables	2	https://link.springer.com/article/10.1007/s00603-019-01790-z https://www.sciencedirect.com/science/article/pii/S1995822622000024 https://link.springer.com/article/10.1007/s00603-022-02956-y

			tests will be used to refine the tool design and improve performance.			
6	Prof. Rami Ghannam	AI-Driven Tennis Ball Trajectory and Spin Analysis	The goal of this project is to develop a compact computer vision-based system to analyse the trajectory of a tennis ball launched from a ball machine. The system will use image processing techniques to track ball motion in real-time and apply artificial intelligence (AI) models to predict ball trajectory, speed and spin characteristics. Based on images collected from a camera and a microcontroller, an algorithm will be developed to extract ball movement data. Students will will also train machine learning models to predict ball trajectory and spin. The project team will consist of two students, who might wish to divide the work so that one focuses on image processing and tracking, while the other works on AI-based predictions and modeling.	Tennis ball machine, NVIDIA Jetson Nano Developer Kit, Logitech HD Camera	2	1) https://pmc.ncbi.nlm.nih.gov/articles/PMC3990883/ 2) https://pmc.ncbi.nlm.nih.gov/articles/PMC4879439/

7	Bo Liu	AI-driven design of microwave antennas: the next generation methodology	At present, antenna design is mostly carried out by highly skilled engineers. However, AI techniques can obtain designs with high performance that human designers are not able to, and also with a much shorter time-to-market. The CSI Group, University of Glasgow, has developed state-of-the-art algorithms for AI-driven antenna design and was embedded into MATLAB. In this project, you will get familiar with state-of-the-art AI-driven antenna design tools and practice them in simple antenna design cases that appear in daily life. This opportunity will lead to a final year project working on the AI-driven design of modern and advanced antennas, which may lead to publications. According to your performance, future postgraduate study training you to become a first-generation antenna design engineer armed with AI-based design methodology is possible. This project requires outstanding problem-solving skills and the student must be a quick learner. The top 5% of students are encouraged to participate.	software licenses, fabrication	4	The student can learn the related AI knowledge through UofG online course (https://www.coursera.org/specializations/matlab?action=enroll), but it is optional.
8	Julien Le Kernec	Victor Chen's rotor modeling of radar signatures	The student will reproduce code from Victor Chen's book on rotor simulation and then emulate different targets such as drone (x2 students) and rovers (x2 student) configuration and flight path. This	None	4	https://eprints.gla.ac.uk/304566/3/304566.pdf https://go.exlibris.link/SxmhjRD9

			can evolve to a 4D radar simulator where the code for it can be found on Github https://github.com/JASONZ777/4D_radar_simulator_PointNet			
9	Julien Le Kernec	From motion capture to radar emulation	In this project, 2 students will work on getting motion capture data integrated in the victor chen simulation framework and then move to 4D radar if time allows.	None	2	https://eprints.gla.ac.uk/304566/3/304566.pdf https://go.exlibris.link/SxmhjRD9
10	Julien Le Kernec	Development of a phone app for digital biomarker of mental fatigue	Mental fatigue is an important aspect of alertness and wellbeing. Existing fatigue tests are subjective and/or time-consuming. Here, we show that smartphone-based gaze is significantly impaired with mental fatigue, and tracks the onset and progression of fatigue. A simple model predicts mental fatigue reliably using just a few minutes of gaze data. These results suggest that smartphone-based gaze could provide a scalable, digital biomarker of mental fatigue. You role would be to develop the app towards reproducing those results (x2 students)	None	2	https://www.nature.com/articles/s41746-021-00415-6
11	Julien Le Kernec	Measuring HERM lines with radar using a mechanical rotor	The increasing access to drone technology over the past decade has resulted in new technological adaptions that are beneficial in many sectors. However, this has led to an increased risk of this technology being exploited for malicious purposes. This has also caused an increased presence of	None	2	https://research.birmingham.ac.uk/en/publications/multi-rotor-drone-micro-doppler-simulation-incorporating-genuine-

			drones in civilian airspace and interference with the day-to-day operation of airports. Events such as the closure of Gatwick in December of 2018 and a hostile drone attack in Saudi Arabia in September 2019 have publicized the need for counter-drone technology. A key component of counter-drone technology is the noncooperative detection of drones. It is important to be able to discriminate between birds and drones to avoid too many false alarms. One of the components that distinguish the 2 is HERM lines. Small airborne targets have been shown to exhibit distinguishing features in their frequency domain spectra that relate to their micro-Doppler signatures. Drones that have rotating blades cause a modulation in addition to the main body Doppler, resulting in multiple micro-Doppler components. In contrast, birds that otherwise have a similar echo strength to drones tend to present with one or two components in their micro-Doppler responses due to the beating effect of their wings. Birds can also fly in flocks, which results in Doppler signatures that may closely resemble a drone target. In this project, you will work on the effect of polarisation and interferometry in the detection of			

			HERM lines for a hovering drone and then move towards some more realistic flight parameters with different attitudes to study the evolution of HERM lines in radar micro-Doppler to devise effective detection comparing machine learning versus rule-based approaches. You will work with an X band component of the shelf radar for frequency diversity and polarisation effects on drone HERM lines from an FMCW radar.			
12	Julien Le Kernec	Classification of motion capture data and emuated radar signatures with machine learning techniques	The 2 students will look at the classification accuracy difference between motion capture and emulated radar signatures using the victor chen framework	None	2	https://eprints.gla.ac.uk/304566/3/304566.pdf https://go.exlibris.link/SxmhjRD9
13	Lianping Hou	Widely Tunable Photonic Filters for Next-Generation Optical Communication	Project Overview This summer school project will introduce undergraduate students to cutting-edge research in widely tunable photonic filters, a key technology for advanced optical communication and microwave photonics. Based on the recent work by Zhu et al. (2025) on equivalent chirped four-phase-shifted sampled Bragg gratings (EC-4PS-SBGs), students will explore novel photonic filter designs, their fabrication processes, and practical applications. Objectives • Understand the fundamental	Optical fibers, electrical test probes, FDTD, and COMSOL simulation tools	2	S. Zhu, B. Yuan, M. Al-Rubaiee, Y. Sun, Y. Fan, A. S. Hezarfen, S. J. Sweeney, J. H. Marsh, and L. Hou, “Widely Tunable Photonic Filter Based on Equivalent Chirped Four-Phase-Shifted Sampled Bragg Gratings,” ACS Photonics, 2025. (https://doi.org/10.1021/acsphotonics.4c01899)

			principles of photonic filters and their role in modern communication networks. • Analyze the design and operational characteristics of EC-4PS-SBG-based filters. • Gain hands-on experience with optical simulation tools such as Lumerical and MATLAB. • Conduct experimental measurements of filter responses using optical test setups. • Investigate potential applications in microwave photonics and signal processing. Expected Outcomes • A strong foundational understanding of tunable photonic filters. • Practical skills in simulation, experimental characterisation, and data analysis. • Enhanced technical communication through report writing and presentations. • Potential contributions to ongoing research in photonic integrated circuits. Conclusion This project provides an excellent opportunity for undergraduate students to engage in state-of-the-art photonics research, develop hands-on skills, and contribute to advancing optical communication technologies. Exceptional			

			students may be encouraged to pursue further research opportunities or co-author conference presentations based on their findings. This project is not subject to export control as it builds upon the work published in our paper: S. Zhu, B. Yuan, M. Al-Rubaiee, Y. Sun, Y. Fan, A. S. Hezarfen, S. J. Sweeney, J. H. Marsh, and L. Hou, "Widely Tunable Photonic Filter Based on Equivalent Chirped Four-Phase-Shifted Sampled Bragg Gratings," ACS Photonics, 2025. (https://doi.org/10.1021/acsphotonics.4c01899).			
14	Lianping Hou	Generation and Applications of Optical Frequency Combs Using Mode-Locked Lasers	Project Overview This summer school project will introduce undergraduate students to the concept of optical frequency combs and their generation using passively mode-locked lasers. Based on the work by Hou et al. (2020) on asymmetric multiple quantum well (MQW) passively mode-locked lasers for 100 GHz frequency comb generation, students will explore the design, simulation, and characterization of frequency combs and their applications in optical communications and spectroscopy. Objectives • Understand the fundamentals of	Optical fibers, electrical test probes, FDTD, and MATLAB simulation tools	2	L. Hou, Y. Huang, Y. Liu, R. Zhang, J. Wang, B. Wang, H. Zhu, B. Hou, B. Qiu, and J. H. Marsh, "Frequency comb with 100 GHz spacing generated by an asymmetric MQW passively mode-locked laser," Opt. Lett., vol. 45, no.10, pp.2760-2763, 2020. DOI: 10.1364/OL.392191

			optical frequency combs and mode-locking techniques. • Study the operational principles of MQW passively mode-locked lasers. • Gain experience with optical simulation tools such as Lumerical and MATLAB. • Conduct experimental measurements of mode-locked laser outputs. • Investigate potential applications in high-speed optical communications and metrology. Expected Outcomes • A solid understanding of optical frequency comb generation and mode-locking techniques. • Hands-on skills in simulation, laser characterisation, and data analysis. • Improved technical communication through report writing and presentations. • Encouragement for students to pursue further research opportunities in photonics. Conclusion This project provides undergraduate students with an opportunity to engage in advanced photonics research, develop technical skills, and contribute to ongoing developments in frequency comb technology. Exceptional students may be			

			encouraged to explore further research opportunities or co-author conference presentations based on their findings. This project does not fall under export control because it repeats the work in our published paper "L. Hou, Y. Huang, Y. Liu, R. Zhang, J. Wang, B. Wang, H. Zhu, B. Hou, B. Qiu, and J. H. Marsh, "Frequency comb with 100 GHz spacing generated by an asymmetric MQW passively mode-locked laser," Opt. Lett., vol. 45, no.10, pp.2760-2763, 2020. DOI: 10.1364/OL.392191".			
15	Lianping Hou	Optical Control in Photonic Crystal Nanobeam Cavities via the Mechanical Kerr Effect	Project Overview This project explores the mechanical Kerr effect in optomechanical photonic crystal nanobeam cavities (PCNCs). Students will investigate how optical gradient forces (OGFs) induced by high-power light deform nanobeam cavities to tune optical resonances. By fabricating, simulating, and experimentally characterising PCNCs, students will gain hands-on experience in nanophotonics, optical characterisation, and numerical simulations using COMSOL and Lumerical FDTD. The project aims to provide insights into tunable photonic devices for applications such as reconfigurable optical filters and sensors.	Optical fibers, electrical test probes, FDTD, and COMSOL simulation tools	2	A. S. Hezarfen, S. Zhu, B. Yuan, S. J. Sweeney, L. Hou, "Harnessing the Mechanical Kerr Effect for Optical Control in Photonic Crystal Nanobeam Cavities," submitted to CLEO 2025.

			Project Objectives By the end of the project, students will: • Understand the principles of optomechanics, optical gradient forces, and the mechanical Kerr effect. • Learn the fundamentals of photonic crystal nanobeam cavities and their fabrication. • Perform optical characterisation of PCNCs, including transmission spectrum measurements and resonance tuning. • Use COMSOL and Lumerical FDTD to simulate mechanical deformation and optical tuning. • Analyse and interpret experimental and simulation data. • Present findings in a final report and presentation. Expected Outcomes • A deeper understanding of optomechanical interactions in photonic devices. • Hands-on experience in nanophotonic simulations and optical characterisation. • A well-documented report on experimental findings and data analysis. • Improved technical presentation and scientific communication skills. Skills Gained • Optical characterisation			

			techniques • Finite-difference time-domain (FDTD) simulations • Mechanical deformation analysis with COMSOL • Data processing and visualisation • Scientific writing and presentation skills This project is not subject to export control, as it is based on publicly available research detailed in our paper: A. S. Hezarfen, S. Zhu, B. Yuan, S. J. Sweeney, L. Hou, "Harnessing the Mechanical Kerr Effect for Optical Control in Photonic Crystal Nanobeam Cavities," submitted to CLEO 2025.			
16	Lianping Hou	Design and Characterization of a Multi-Wavelength Mode-Locked DFB Laser with Uniform Bragg Gratings	Project Overview: This project focuses on designing and characterising a multi-wavelength mode-locked Distributed Feedback (DFB) laser that uses uniform Bragg gratings for multi-wavelength mode-locking. Mode-locked lasers, particularly those with multi-wavelength operation, are essential for applications in telecommunications, spectroscopy, and Dense Wavelength Division Multiplexing (DWDM). This project involves the design of a DFB laser, including simulation of its optical properties, understanding the role	Optical fibers, electrical test probes, FDTD, and MATLAB simulation tools	2	M. Al-Rubaiee, X. Sun, B. Yuan, Y. Fan, S. Zhu, Y. Sun, J. H. Marsh, S. J. Sweeney, L. Hou, "Tri-Wavelength Mode-Locked DFB Laser with Uniform Bragg Grating," submitted to CLEO 2025.

			of Bragg gratings in mode-locking, and applying experimental characterisation techniques such as optical spectrum analysis and autocorrelation to analyse the device's performance. By completing this project, students will understand key concepts in photonics, laser design, and mode-locking, as well as acquire practical experience with simulations and experimental characterisation. Objectives: 1. Design a Multi-Wavelength Mode-Locked DFB Laser: Learn how to design a Distributed Feedback (DFB) laser capable of multi-wavelength mode-locking using uniform Bragg gratings. 2. Simulate the Laser Performance: Utilise simulation tools to predict the optical spectrum and performance of the designed DFB laser, including multi-wavelength lasing, pulse width, and repetition rates. 3. Experimental Characterization (Virtual or Experimental): Understand the measurement techniques for characterising mode-locked DFB lasers, including the use of an Optical Spectrum Analyzer (OSA) and Autocorrelation (AC) measurements. 4. Data Analysis and Reporting:			

			Analyse the experimental and simulation results, and compile a comprehensive report detailing the design process, results, and conclusions. 5. Presentation of Findings: Prepare and present the design and results of the project in a concise and clear presentation. Expected Outcomes: By the end of the project, students will be able to: 1. Design a Multi-Wavelength Mode-Locked DFB Laser: Understand the principles of DFB lasers and how to design them to operate with multiple wavelengths. 2. Simulate Laser Performance: Accurately simulate and predict the performance of a tri-wavelength mode-locked DFB laser, focusing on spectral output and pulse characteristics. 3. Understand Measurement Techniques: Gain practical knowledge in characterising mode-locked lasers, including spectrum analysis and autocorrelation measurements. 4. Analyse Experimental Data: Be able to analyse and interpret laser data, including spectral measurements and pulse widths, to assess laser performance. 5. Communicate Results Effectively: Present the project's			

			design, results, and implications through a report and a final presentation. Skills Gained: 1. Laser Design and Simulation: Learn to design semiconductor lasers using simulation software, including optimising parameters like microcavity length and grating period. 2. Photonics Measurement Techniques: Gain hands-on experience (or virtual experience) with tools for measuring laser performance, including optical spectrum analysers and autocorrelation devices. 3. Data Analysis and Interpretation: Develop skills in analysing complex data, understanding optical spectra, and measuring pulse width and repetition rate from time-domain signals. 4. Scientific Writing and Reporting: Strengthen technical writing skills by documenting the design, experimental methods, results, and conclusions in a professional report. 5. Presentation Skills: Enhance communication skills by preparing and presenting a concise and clear project presentation to an audience.			

			This project is not subject to export control, as it is based on publicly available research detailed in our paper: M. Al-Rubaiee, X. Sun, B. Yuan, Y. Fan, S. Zhu, Y. Sun, J. H. Marsh, S. J. Sweeney, L. Hou, "Tri-Wavelength Mode-Locked DFB Laser with Uniform Bragg Grating," submitted to CLEO 2025.			
17	Lianping Hou	Multi-Wavelength Mode-Locked DFB Lasers Using Chirped Sampled Bragg Gratings for Optical Communications	Project Overview Mode-locked distributed feedback (DFB) lasers are compact and efficient sources for applications in optical communication and spectroscopy. This project focuses on the design, fabrication principles, and characterisation of a four-wavelength mode-locked DFB laser using chirped sampled Bragg gratings (C-SBGs). Students will gain theoretical insights into mode-locking, semiconductor laser operation, and experimental skills in optical characterisation. Project Objectives By the end of the project, students will: 1. Understand the principles of mode-locking and multi-wavelength DFB lasers. 2. Learn about chirped sampled Bragg gratings (C-SBGs) and their impact on laser stability. 3. Perform optical characterisation of a multi-wavelength mode-	Optical fibers, electrical test probes, FDTD, and MATLAB simulation tools	2	M. Al-Rubaiee, B. Yuan, Y. Fan, S. Zhu, Y. Sun, X. Sun, J. H. Marsh, S. J. Sweeney, L. Hou, "Four-Wavelength Mode-Locked DFB Laser Using Chirped Sampled Bragg Grating," submitted to CLEO Europe 2025.

			locked laser, including spectrum, autocorrelation, and pulse width measurements. 4. Analyse data to evaluate the performance of mode-locked laser sources. 5. Present findings through a final report and presentation. Expected Outcomes • A comprehensive understanding of mode-locked DFB laser operation. • Hands-on experience in semiconductor laser characterisation techniques. • A well-documented report on experimental findings and data analysis. • Improved technical presentation and scientific communication skills. Skills Gained • Optical characterisation techniques • Data analysis and visualisation • Scientific writing and presentation • Problem-solving and teamwork This project is not subject to export control, as it is based on publicly available research detailed in our paper: M. Al-Rubaiee, B. Yuan, Y. Fan, S. Zhu, Y. Sun, X. Sun, J. H. Marsh, S. J. Sweeney, L. Hou, "Four-Wavelength Mode-Locked DFB			

			Laser Using Chirped Sampled Bragg Grating," submitted to CLEO Europe 2025.			

18	Hasan Abbas	Construct Super resolution microscope and explore denoising algorithms	Structured Illumination Microscopy (SIM) has been pivotal in transcending the diffraction limit of conventional optical microscopy, enabling the visualization of biological structures with doubled resolution. Despite its success, traditional SIM reconstruction methods rely on complex parameter estimations and deconvolution processes, limiting their performance and scalability. In this project, you will be introduced to openUC-2 which is an open-source modular way to construct microscopes. In parallel, you will also use SISRR-SIM, a novel deep learning-based approach that addresses these challenges through an encoder-decoder neural network architecture. SRR-SIM reconstructs high-frequency details lost during optical imaging, surpassing the capabilities of traditional algorithms. You will learn performance assessment criteria such as the Structured Similarity Index (SSIM) to assess the reconstruction quality.	Microscope components (optics, electronics, 3D printed structures) come out at £360 per person.	4	Hannebelle, Mélanie TM, et al. "Open-source microscope add-on for structured illumination microscopy." Nature Communications 15.1 (2024): 1550. Marcel Müller, Viola Mönkemöller, Simon Hennig, Wolfgang Hübner, Thomas Huser (2016). "Open-source image reconstruction of super-resolution structured illumination microscopy data in ImageJ", Nature Communications, doi: 10.1038/ncomms10980 Cao, Ruijie, et al. "Open-3DSIM: an open-source three-dimensional structured illumination

						microscopy reconstruction platform." Nature Methods 20.8 (2023): 1183-1186 Wang, Haoran, et al. "UCsim2: 2D structured illumination microscopy using UC2." bioRxiv (2021): 2021-01.
19	Shuja Ansari	Real-Time Sensor Integration and Communication Using Raspberry Pi and Smartphone	This project focuses on developing a real-time sensor integration system using Raspberry Pi (RPi) and Bluetooth-enabled smartphone communication. The objective is to interface various sensors (such as temperature, humidity, motion, or light sensors)	RPi, cloud instances for App hosting, sensors	4-6	RPi tutorials, app building tutorials, Bluetooth comms

			with an RPi, process the collected data, and establish a two-way communication link with a smartphone via Bluetooth. Students will configure the Raspberry Pi to collect sensor data, process it, and transmit the readings to a smartphone application in real time. The smartphone app will not only display sensor readings but also allow users to send control commands back to the RPi. This bidirectional communication will enable remote monitoring and control of connected systems. The project will involve: • Configuring the Raspberry Pi for sensor interfacing. • Implementing Bluetooth communication between the RPi and a smartphone. • Developing a mobile application for real-time sensor data visualisation and control. • Ensuring reliable data transmission and low-latency response. • Designing a simple user interface for interaction with the system. This is a systems integration project that requires students to apply skills in embedded systems, wireless communication, and software development, fostering a			

			multidisciplinary approach to IoT-based applications.			
20	Muhammad	GUI-Based Energy Data Acquisition and Forecasting for Power Utilities	Objectives: This project aims to develop a Graphical User Interface (GUI) to facilitate data acquisition from power utilities and enable load forecasting. To achieve this, the project is divided into two main components, which will ultimately be integrated: Development of a GUI: This component focuses on creating an interface that allows users (e.g., power system operators and researchers) to access, filter, and download historical load data from utilities. The data will be retrievable for a specified date range and exported in CSV format for further processing. Development of Load Forecasting Models: This component involves implementing and evaluating various forecasting models for short-term load forecasting. The acquired data from the GUI will serve as input for these models to generate accurate predictions. Overall, the project will integrate a GUI-based data acquisition	Python packages will be required for both GUI development and load forecasting.	(Flexible), Prefer atleast 2 students working in a team to develop the GUI as well as the load forecasting models. However, the student must familier with Python or programming in general	https://ieeexplore.ieee.org/document/10855140

			system with the forecasting models, enabling automated data retrieval, processing, and prediction of electricity demand. Resource: We will reference a similar study (linked below) and attempt to reproduce its results by accessing data from similar utilities mentioned in the paper. If we have enough time, we will add more features to this project. Tools: Python packages for both GUI development and load forecasting.			

21	Qingshen Jing	Exploring the Fundamentals of Triboelectric Nanogenerator for Innovative Design.	Triboelectric nanogenerator is a recently developed energy harvesting technology that converts mechanical energy into electricity, with the benefit of low cost, wide material selection, high energy density and simple structure. It is a revolutionary power solution for portable and wearable electronics as well as internet of things and beyond. Currently there are several types of operation modes for triboelectric nanogenerators, and each has their advantages in unique application scenarios. In this project you will start from using simulation software to understand the working mechanism of different modes of triboelectric nanogenerators, from where you will think about and demonstrate new designs for their applicability and effectiveness for innovative applications.	For simulation: Comsol Multiphysics with electric and mechanics modules. For experiment: various polymer sheets, glue, tape, conductive tape, LED, acrylic board, with access for workshop processing, etc.	3	1. Recent progress of triboelectric nanogenerators: From fundamental theory to practical applications (https://doi.org/10.1002/eom2.12059 or https://onlinelibrary.wiley.com/doi/full/10.1002/eom2.12059) 2. Recent Advances in Triboelectric Nanogenerators: From Technological Progress to Commercial Applications (https://doi.org/10.1021/acsnano.2c12458 or https://pubs.acs.org/doi/full/10.1021/acsnano.2c12458)

22	Qingshen Jing	Design Microfluidic Based Force Sensor: From Simulation to Reach Innovative Insights	Customizable force sensors with thin morphology, bio-compatibility and low cost have always been welcomed in medical and health care fields. A thin, conformable microfluidic force sensor is proposed that can effectively convert forces into electric signals via microfluidic phenomenon in confined spaces. The project requires you to comprehensively optimize the structure design by consider about tuning the key factors using simulation. Prototype is encouraged to be built to demonstrate the optimization.	For simulation: Comsol Multiphysics with electric and mechanics modules. For experiment: various polymer sheets, glass slides, conductive ink, PDMS, 3D printing materials, Arduino platforms.	2	1. Aerosol-jet-printed, conformable microfluidic force sensors (https://doi.org/10.1016/j.xcrp.2021.100386 or https://www.sciencedirect.com/science/article/pii/S266638642100076X) 2. Conformable and robust microfluidic force sensors to enable precision joint replacement surgery (https://doi.org/10.1016/j.matdes.2022.110747 or https://www.sciencedirect.com/science/article/pii/S0264127522003690)

23	Wasim Ahmad	Emotion Recognition to Enhance Human-Robot Interaction	The use of robots in the service and healthcare sector is on the rise, where human-robot interaction (HRI) will become the norm. Therefore, it is expected to make human-robot interaction more accessible and natural. This project aims to use published models and tools to implement an emotion recognition system for robots that can recognise the speaker's inner emotions and ideological activity using their voice.	Audio and Video sensors, hardware kit and MATLAB	4	https://www.sciencedirect.com/science/article/pii/S0167639319302262 https://www.researchgate.net/publication/322651210_Speech_emotion_recognition_research_an_analysis_of_research_focus
24	Wasim Ahmad	Implementation of Conversational Interaction between Human and Robot	With the increasing use of robots in the service sector, face-to-face human-robot communication is likely the most conventional form of human-robot interaction. However, the nature of the conversation in such an interaction depends on the situation in which the exchange occurs. As a result, designing communication for human-robot interaction has gained interest in recent years, although modelling natural conversational interaction between humans and robots is non-trivial. This project aims to employ published tools and available SDKs for conversational AI to design and implement multi-modal human-robot communication interactions.	Pepper Social Robot, several sensors and GPU, and software	4	https://us.softbankrobotics.com/pepper https://standardbots.com/blog/pepper-robot?srsltid=AfmBOorqHKYeeeLTC-V_5tDPe9Ayu3e25wfPRS1JiW6k7nwVs8U0btPg

25	Qusay Al-Taai	Fabricating and Realising an RTD-Based Anthropomorphic Spiking Source for Neuromorphic Applications	This project explores Resonant Tunneling Diodes (RTDs) as a potential source of anthropomorphic spiking behaviour, mimicking biological neurons for neuromorphic computing. • The goal is to fabricate and characterize an RTD-based nonlinear oscillator that produces spike-like signals similar to biological neurons. • Students will analyze RTDs' current-voltage (I-V) characteristics and their dynamic response under varying bias conditions. • The project will focus on designing and fabricating RTD devices for spiking generation and investigating their feasibility for neuromorphic systems. Learning Outcomes: • Hands-on experience in micro/nanofabrication techniques (photolithography, thin-film deposition, etching). • Understanding of semiconductor device physics and electrical characterization methods. • Exposure to neuromorphic computing concepts (for RTD project) and how hardware can mimic biological neurons. • Data analysis and comparison with existing literature to evaluate device performance.	4-6 samples (12x12 mm) from RTD wafer, Photolithography tools (MA6 in JWNC) , Etching system (wet/dry) , Probe station for electrical testing	2-3 students	Project Description This project focuses on designing and fabricating a Resonant tuning diode (RTD) as a nonlinear oscillator capable of mimicking biological neuron spiking behaviour. It will provide students with hands-on experience in neuromorphic engineering, and they will explore how semiconductor devices can emulate biological neural networks. The students will reproduce existing designs of RTD circuits used for generating spike-like signals, analyse their electrical characteristics, and evaluate their feasibility for future neuromorphic

						applications. The emphasis will be on understanding the spiking mechanisms of RTDs and how their nonlinear I-V characteristics can be harnessed for neuromorphic computing systems. Key Objectives: • Fabricate and characterize an RTD-based spiking circuit. • Understand the relationship between RTD structural parameters and its nonlinear electrical response. • Analyse and reproduce anthropomorphic spike-like waveforms from RTD-based circuits. • Compare RTD behaviour with biological neuron models and discuss their relevance in

						neuromorphic computing. Project Duration & Student Workload: - 8 weeks total, with structured activities: - Week 1-2: Literature review, device design, and process planning. - Week 3-5: Fabrication steps (lithography, deposition, etching). - Week 6-7: Electrical characterisation and data analysis. - Week 8: Final report preparation and presentation. Project Methodology Week 1-2: Literature Review and Project Planning • Review relevant literature on RTDs and pulse mechanisms. • Study the structure of resonant tunnel

						diodes and their applications in neuromorphic circuits. • Develop a detailed device fabrication plan and measurement procedures. Week 3-5: Fabrication Process • Prepare substrate (GaAs or InGaAs). • Fabricate RTDs by layer and pattern deposition. • Perform device isolation and contact configuration using photolithography and etching techniques. Week 6-7: Electrical Characterization and Testing • Perform current-voltage (I-V) measurements to analyze RTD nonlinearity. • Perform pulse circuit setup using

						RTDs and passive components (resistors and capacitors). • Record and analyze pulse-like signal responses under different bias conditions. Week 8: Data Analysis and Reporting • Compare experimental results with theoretical predictions and literature. • Analyze the behaviour of nerve impulses in comparison to biological neurons. • Compile the results into a final report and present the project results. Funding Justification (£400 per student) • Materials and consumables: Substrates, resists, solvents,

						metals, and circuit components. • Fabrication-related expenses: Usage of lithography systems, deposition materials, and etching services. • Measurement and analysis expenses: Testing equipment usage, characterization software access, and lab fees.

26	Muhammad Aslam	Economic Modeling/Optimization of Renewables and Battery Energy Storage System (BESS) in a Grid	This is very simple but interesting project focusing on developing an economic model for integrating renewable energy sources (PV and wind) along with a Battery Energy Storage System (BESS) into a grid. The objective is to minimize total costs, including investment and operational expenses. The investment cost accounts for PV, wind, and BESS installation, considering unit costs and capacity constraints. The operational cost includes grid electricity prices, renewable generation, and BESS operation, incorporating both variable and fixed costs. The model ensures optimal power flow while maintaining economic feasibility and energy balance within the system. Python optimization package PuLP wil be used	Python packages for optimization	2	[Basic] Build Optimization Model to Schedule Battery's Operation in Power Grid Systems https://medium.com/@yeap0022/basic-build-optimization-model-to-schedule-batterys-operation-in-power-grid-systems-51a8c04b3a0e https://ieeexplore.ieee.org/document/9069731
27	Niamat Hussain	Design and characterization of microsrip patch antenna for ISM (industrial, scientific, and medical) bands applications	This project focuses on the design, simulation, and fabrication of a microstrip patch antenna operating in the ISM bands (e.g., 2.4 GHz or 5.8 GHz) for wireless communication and IoT applications. The antenna's performance will be analyzed in terms of gain, bandwidth, return loss, and radiation pattern using simulation tools like CST or HFSS, followed by testing to validate its its simulated results.	CST software, PCB Milling Machine, substrate	2	https://www.antenna-theory.com/ https://www.mdpi.com/1424-8220/22/15/5558

28	Niamat Hussain	Circularly Polarized MIMO Antenna for Satellite Communication	This project involves the design and analysis of a circularly polarized (CP) MIMO antenna for satellite communication. The antenna will be optimized for high gain and a low axial ratio to ensure reliable signal reception, even in the presence of polarization mismatches. Performance will be validated through simulations using CST or HFSS, followed by prototype fabrication and testing. Students will gain hands-on experience in CP antenna design, characterization, fabrication, and performance measurement.	CST, PCB Milling/Photolithography Machine, Vector Network Analyzer, substarte	2	https://www.antenna-theory.com/ https://www.nature.com/articles/s41598-023-42569-1
29	Muhammad Aslam	Comparison of AC-DC Converter Topologies Used for On-Board Charger for Two-Wheeler Electric Vehicle	This project focuses on designing and comparing two AC-DC converter topologies for an On-Board Charger (OBC) in a Two-Wheeler Electric Vehicle. An existing system (link is given below) uses a Totem-Pole Power Factor Correction (PFC) converter, and we aim to replace it with a Boost PFC converter. The goal is to analyze performance differences and determine the best option for this application. We will evaluate both converters based on three key performance metrics: Total Harmonic Distortion (THD): Should be below 5% Power Factor (PF): Should be above 80%	MATLAB/Simulink	2	https://uk.mathworks.com/help/sps/ug/on-board-charger-for-two-wheeler-electric-vehicle.html https://ieeexplore.ieee.org/document/8993306 https://www.monolithicpower.com/en/support/videos/high-power-pfc-totem-pole-pfc-vs-interleaved-boost-pfc.html https://www.edn.com/a-comparison-of-interleaved-boost-and-totem-pole-pfc-topologies/

			Efficiency: Should exceed 90% By comparing the outputs of both topologies, we will determine which is more suitable for an On-Board Two-Wheeler Electric Vehicle Charger in terms of efficiency, power quality, and overall system performance. The model is available here. https://uk.mathworks.com/help/sps/ug/on-board-charger-for-two-wheeler-electric-vehicle.html			
30	Niamat Hussain	Isolation Improvement of closely spaced MIMO antennas	This project focuses on enhancing the isolation between closely spaced MIMO antennas to minimize mutual coupling and improve overall system performance. Various techniques, such as defected ground structures (DGS), electromagnetic bandgap (EBG) structures, neutralization lines, and decoupling networks, will be explored. Simulations using CST or HFSS will evaluate isolation performance, followed by prototype fabrication and measurement of key parameters	CST software, CNC/lithography machine, Vector Network Analyzer, substrate	2	https://www.antenna-theory.com/ https://ieeexplore.ieee.org/abstract/document/9750942

			like S-parameters, envelope correlation coefficient (ECC), and diversity gain.			
31	Anthony Centeno	Using open source electromagnetic simulation software to model microwave and photonic devices	The student will investigate open source software that can be used in electromagnetic simulations in place of expensive and geographically restricted software.	No consumables. But access to workstations and/or a HPC will be required.	1-2	1. Microwave Circuit Modeling Using Eelectromagnetic Field Simulation, Wolfgang J. R. Hoefer, Daniel G. Swanson Jr. ISBN: 9781580536882 2. Numerical electromagnetics: the FDTD method by Inan, Umran S; Marshall, Robert A 2011. 3. https://meep.readthedocs.io/en/master/ (MEEP-FDTD software) 4. http://ddscat.wikidot.com/user-guide (Discrete Dipole Approximation for photonics) 5. https://pypi.org/project/pyGDM2/ 6. https://www.nottingham.ac.uk/rese

						arch/groups/ggiemr/our-research/large-scale-electromagnetic-modelling/tlm-time-domain-modelling-code-ggitlm.aspx

32	Andrew Glidle	An automated method for measuring the focal length of lenses used in optical system research	One of the problems in research groups who have lots of optical components is that people never put things back in the right boxes... with optics research, this means that there are large collections of lenses for which people no longer know what the focal length is! This project will build a simple instrument to automatically measure the focal length by collecting images from a target on a CMOS camera and then using software (that the student writes) to automatically calculate the focal length of the unknown lens. The skills acquired will be a good understanding of optical systems and the factors that need to be considered in optical alignment, different types of optomechanical components, software writing and how to generate an 'app' that can be used by inexperienced users. These skills would be useful for people wanting to learn about instrument development and/or optical/microscopy systems. The work would be carried out in the Advanced Bioengineering group labs at the Advanced Research Centre (ARC).	small number of Thorlabs type components	1-2	Any books on classical optics e.g. Optics by Hecht (other titles can be supplied to interested students) - the optics used in this project is 'straight-line' optics and apart from making the instrument (which will be extremely useful), the main advantage will be the skills learned in optical alignment, hardware interfacing and app writing.

33	Ahmad Taha	Internet-of-Things-based Smart Sustainability in Homes and Offices	The world is facing several major challenges, and the race to meet the net-zero carbon target is the biggest of them. The building sector alone has a 30-50% share in the annual global greenhouse emissions, partly due to the inefficient means of using and operating them, including the energy efficiency of devices/appliances including their phantom load (idle consumption) which can account for 10% of the monthly bill. Therefore, it is crucial to explore innovative approaches to tackle this issue, and Smart Home Technology (SHT) has emerged as a promising solution. The proposed project "Internet-of-Things-based Smart Sustainability in Homes and offices" aims to build a system that captures the energy consumption of everyday use appliances and devices used in the home and in offices to explore optimisation opportnities. Examples of appliances and other devices targeted in this project are white goods, i.e., washing machines, tumble dryers, cookers, desktop computers and screen monitors. Objectives: Data Collection and Management: Design and implement an IoT network to collect and manage	Energy monitoring sensors and an edge server (this can be joint with the other project I propose).	2 to 3	- https://www.sciencedirect.com/science/article/pii/S2352484724003202 - https://pmc.ncbi.nlm.nih.gov/articles/PMC7037999/ - https://nodered.org/docs/tutorials/ - https://www.geeksforgeeks.org/python-ai/

			data from various sources to build energy consumption profiles of different appliances and devices. (Student 1) Design, develop, and test an algorithm for monitoring, coordinating, and controlling the appliances/devices. The student is to explore the best approach to designing this algorithm through, e.g., Machine/Deep Learning, Fuzzy Logic, etc. (Student 2) Design and develop an interactive user interface for data visualisation. (Student 1 and Student 2)			
34	Ahmad Taha	IoT-based Contactless Human Activity Recognition	Contactless Human Activity Recognition (HAR) has gained significant attention in the past 10+ years to offer solutions that would enable privacy-preserving means of monitoring occupancy and activities in homes and offices. Existing approaches for HAR, such as cameras and wearable sensors, present limitations related to privacy, low-light conditions, installation costs, and inconvenience. To address these challenges, various techniques have been proposed to use contactless technology that leverages data from IoT devices to develop a HAR framework. In this project, the aim is for	Edge server (this can be joint with the other project I propose)	4	- https://nodered.org/docs/tutorials/ - https://www.geeksforgeeks.org/python-ai/ - https://ieeexplore.ieee.org/abstract/document/9740207/ - https://link.springer.com/article/10.1007/s10462-021-10116-x

			students to learn how to collect, handle, and manage data from IoT devices and develop AI algorithms to analyse, classify, and predict various activity behaviours. This will include data from single and multiple IoT sources. The data will be collected through a University of Glasgow-owned IoT sensor network. Objectives: - AI Stage: Develop machine learning (ML)/ deep learning (DL) algorithms encompassing classification and clustering techniques to enable activity monitoring using data from IoT sensors. (Students 1 and 2) - System Integration, Data Analysis, and Visualisation: Design a dashboard that seamlessly integrates with the system, enabling real-time visualisation of energy consumption and the recognised activities e.g., occupancy, and activity types, e.g., cooking, watching TV. This phase will also involve analysing the collected data to identify activity patterns over a prolonged period of time. (Students 3 and 4)			

35	Yao Sun	Encoder and Decoder Design for Semantic Communication	In this project, we will teach students how to establish a semantic communication network based on some basic deep learning algorithms. The students will learn the basic concept of semantic communication as well as wireless networking technology. Some coding skills will also be trained. Finally, the students will repeat an existing research work. All the relevant papers, datasets and codes are from open sources.	Computing nodes	3-4	[1] Yao Sun, Lan Zhang, Lingke Guo, et al. S-RAN: Semantic-aware Radio Access Networks. IEEE Communications Magazine, 2024. [2] B. Güler, A. Yener, and A. Swami, “The semantic communication game,” IEEE Transactions on Cognitive Communications and Networking, vol. 4, no. 4, pp. 787–802, 2018. [3] H. Xie, Z. Qin, G. Y. Li, and B.-H. Juang, “Deep learning enabled semantic communication systems,” IEEE Transactions on Signal Processing, vol. 69, pp. 2663–2675, 2021. [4] C. E. Shannon, “A mathematical theory of communication,” The Bell system technical journal,

						vol. 27, no. 3, pp. 379–423, 1948.

36	Yao Sun	Basic semantic communication network design	In this project, we would like to teach how to design an update policy for an intelligent semantic communication system. The students will learn the basic concept of semantic communication, and finally, repeat an existing research work. All the papers, datasets and codes are from open resources.	Computing nodes	3-4	[1] Yao Sun, Lan Zhang, Lingke Guo, et al. S-RAN: Semantic-aware Radio Access Networks. IEEE Communications Magazine, 2024. [2] B. Güler, A. Yener, and A. Swami, "The semantic communication game," IEEE Transactions on Cognitive Communications and Networking, vol. 4, no. 4, pp. 787–802, 2018. [3] H. Xie, Z. Qin, G. Y. Li, and B.-H. Juang, "Deep learning enabled semantic communication systems," IEEE Transactions on Signal Processing, vol. 69, pp. 2663–2675, 2021. [4] C. E. Shannon, "A mathematical theory of communication," The Bell system technical journal,

						vol. 27, no. 3, pp. 379–423, 1948.

37	Yao Sun	Generative AI based Efficient Knowledge Construction for Semantic Communication	In this project, we would like to teach how to design an update policy for an intelligent semantic communication system. The students will learn the basic concept of semantic communication, and finally, repeat an existing research work. All the papers, datasets and codes are from open resources.	Computing nodes	3-4	[1] Yao Sun, Lan Zhang, Lingke Guo, et al. S-RAN: Semantic-aware Radio Access Networks. IEEE Communications Magazine, 2024. [2] B. Güler, A. Yener, and A. Swami, "The semantic communication game," IEEE Transactions on Cognitive Communications and Networking, vol. 4, no. 4, pp. 787–802, 2018. [3] H. Xie, Z. Qin, G. Y. Li, and B.-H. Juang, "Deep learning enabled semantic communication systems," IEEE Transactions on Signal Processing, vol. 69, pp. 2663–2675, 2021. [4] C. E. Shannon, "A mathematical theory of communication," The Bell system technical journal,

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