Project Number	Project Title	Project Description	Project Supervisor	Max student on project	Reading List for Project
1	Robot for education	The student will learn the project skills by undergoing the replication of existing work on the use of robots for education. In this project, the student will learn about project planning, resource management and independent learning skills by replicating an existing work on the use of robot for education.	Sajjad Hussain	2	https://robotis.co.uk/turtle-burg.html https://link.springer.com/chapter/10.1007/978-3-030-26945-6_16
2	A Blockchain Platform for Data Sharing and Trading	The overall objective of the project is to create a collaborative environment based on blockchain technology for students to share their ideas and pieces of assignment/report (in particular for collaborative teamwork assessments) with others in a secure and privacy-preserving way while preventing plagiarism. Students are expected to learn basic programming skills by reproducing the results from existing research papers (e.g., BeSharing: A Copyright-aware Blockchain-enabled Knowledge Sharing Platform in BRAINS'22)	Lei Zhang	4	BeSharing: A Copyright-aware Blockchain-enabled Knowledge Sharing Platform in BRAINS'22 BeepTrace: Blockchain-enabled Privacy-preserving Contact Tracing for COVID-19 Pandemic and Beyond.
3	AI-driven design of microwave antennas: the next generation methodology	At present, antenna design is mostly carried out by high-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 the 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.	Bo Liu	3	Basic knowledge of antennas, AI-driven antenna design: http://ec2-35-176-54-107.eu-west-2.compute.amazonaws.com/
4	From animation files to sensing	The student will work on the translation of motion capture files used for animation to accelerometer data for human activity recognition focusing on gait analysis.	Julien Le Kernec	2	Li, Z., Li, B. and Le Kernec, J. (2020) Activity Recognition System Optimisation Using Triaxial Accelerometers. In: International Conference on 3D Imaging Technology (IC3DIT2019), Kunming, Yunnan, China, 15-18 Aug 2019, ISBN 9789811538667 (doi: 10.1007/978-981-15-3867-4_15) https://resources.mpi-inf.mpg.de/HDM05/
5	Human activty recognition from motion capture to radar microDoppler	The student will capture a dataset with motion capture and radar to compare the radar emulations from the mocap files with the measured data.	Julien Le Kernec	3	Zhou, J. and Le Kernec, J. (2023) 4D radar simulator for human activity recognition. IET Radar, Sonar and Navigation, (doi: 10.1049/rsn2.12468) https://resources.mpi-inf.mpg.de/HDM05/
6	From motion capture to VR visualisation	The student will work on adding avatars to the VR meta 3 headset based on motion-captured data in real-time.	Julien Le Kernec	2	https://resources.mpi-inf.mpg.de/HDM05/
7	Future wireless communication	In the realm of wireless communications, Reconfigurable Intelligent Surfaces (RIS) offer net- work providers the capability to manage the behaviour of electromagnetic signals, encompassing their scattering, reflection, and refraction properties. Numerous research findings have under- scored RIS's effectiveness in controlling wireless wave attributes, such as amplitude and phase, without necessitating intricate equalization and decoding at the receiver's end. However, it's crucial to note that configuring the surface in practical scenarios with frequency-selective fading channels should be carefully addressed across the entire bandwidth. This entails considering a wideband Orthogonal Frequency Division Multiplexing (OFDM) communication system that is based on a practical RIS configuration, involving distinct phase shifts for each element on the surface.	Qammer Abbasi	2	(1) HassounaS, JamshedMA, RainsJ, KazimJU, RehmanMU, AbualhayjaM, MohjaziL, Cui TJ, Imran MA, Abbasi QH. A survey on reconfigurable intelligent surfaces: Wire- less communication perspective. IET Communications. 2023 Mar;17(5):497-537 (2) Hassouna S, Jamshed MA, Ur-Rehman M, Imran MA, Abbasi QH. Configuring recon- figurable intelligent surfaces using a practical codebook approach. Scientific Reports. 2023 Jul 22;13(1):11869 (3) Hassouna S, Jamshed MA, Rehman MU, Imran MA, Abbasi QH. Rate optimization using low complex methods with reconfigurable intelligent surfaces. Journal of Information and Intelligence. 2023 Sep 1;1(3):267-80 (4) Hassouna S, Jamshed, M. A., Ur Rehman, M. , Imran, M. A. and Abbasi, Q. H. (2024) RIS-assisted Near-field Localization Using Practical Phase Shift Model. Submitted to Scientific Reports and received minor revision. B. Conference Proceedings (1) Hassouna S, Jamshed MA, Ur-Rehman M, Imran MA, Abbasi QH. Investigating the Data Rate of Intelligent Reflecting Surfaces with Mutual Coupling and EMI. In2023 IEEE Wireless Communications and Networking Conference (WCNC) 2023 Mar 26 (pp. 1-6). IEEE. (2) Hassouna S, Jamshed MA, Ur-Rehman M, Imran MA, Abbasi QH. Reconfigurable In- telligent Surfaces Aided Wireless Communications with Electromagnetic Interference. In2023 17th European Conference on Antennas and Propagation (EuCAP) 2023 Mar 26 (pp. 1-5). IEEE. (3) Hassouna S, Rains J, Kazim JR, Rehman MU, Imran M, Abbasi QH. Discrete Phase Shifts for Intelligent Reflecting Surfaces in OFDM Communications. In2022 Interna- tional Workshop on Antenna Technology (iWAT) 2022 May 16 (pp. 128-131). IEEE. (4) Hassouna S, Rains J, Kazim JU, Rehman MU, Imran M, Abbasi QH. Investigating The data rate of Intelligent Reflecting Surface Under Different Deployments.

8	Setting up the Optical Table for Microscopy	In the realm of optics, traditional presentations in textbooks often rely on ray or wave diagrams and formulas, which can seem dry and abstract. In this laboratory-based summer school project, you will study optics by bringing the concepts to life through hands-on exploration with lenses, cameras, and optical systems. The aim is to make optical concepts not only understandable but also exciting and visually captivating.	Hasan Tahir Abbas	5	1. IDEX / CVI / Melles Griot Fundamental Optics Guide at www.thorlabs.com/OMC There will be a number of assigned readings from this over the next few labs (particularly, the sections on Performance Factors, Lens Shape, and Lens Combinations). 2. MicroscopyU section on CCD cameras. See CCD Cameras at www.thorlabs.com/OMC 3. Not required, but helpful for reference: Wikipedia articles on "Color," "Phase (waves)," and "Snell's Law." Also, the section on refraction and the interactive tutorial. See Snell's Law and Interactive Tutorial on Snell's Law at www.thorlabs.com/OMC
9	Design, modelling and test of metasurface-based antennas	Antennas play a crucial role in numerous RF systems, including wireless communications, radar, remote sensing, and imaging. There's a notable trend towards miniaturizing antennas to meet the evolving demands of these fields. In this summer project, a collaborative effort among students will focus on identifying, learning, and implementing design methods and modeling skills from existing literature. Together, the group will aim to develop a metasurface-based antenna capable of meeting the requirements of next-generation wireless communication systems.	Chong Li	5	https://ieeexplore.ieee.org/document/6230714
10	Generating Terahertz signals from dual mode DFB lasers	THz radiation is of increasing importance for a variety of new applications, such as medical imaging, remote sensing, and THz communications. One of the techniques used to generate optical THz signals is by photomixing beams from two different distributed feedback (DFB) lasers or alternatively using an extended cavity configuration. Dual mode lasers (DML) utilising integrated distributed Bragg reflectors (DBRs) or DFB laser cavities have also been used. A much simpler DML source for photomixing, capable of uncooled operation and with a simple device structure, is strongly desired. Among the various reported DML configurations, simultaneous emission from two longitudinal modes within the same cavity is very appealing because the device is compact, gives a stable beat frequency with high spectral quality, can be manufactured at low cost and is straightforward to package. DMLs operating in the 1.5 µm telecommunications window for silica fibre are most desirable. At this wavelength, a plethora of components has been developed to modulate, control, and manipulate optical signals, and erbium-doped fibre amplifiers (EDFAs) can be used to increase the signal power to hundreds of Watts if required. We have developed a DML using sampled Bragg grating (SBG) structures with the reconstruction equivalent chirp (REC) technique based on π phase shifted SBG (PPS-SBG). Compared with conventional SBGs (C-SBG), PPS-SBGs have the entire cavity filled with π-phase shifted gratings and the coupling coefficient κ of the ±1st-order will double and the 0th-order mode is eliminated. So, this kind of DML will have two longitudinal modes lasing simultaneously within the same cavity separated by the frequency between +1st –order and −1st –order. Both modes are affected by much the same electrical, thermal and mechanical fluctuations, also known as the common-mode-noise rejection effects. The frequency difference between the modes is determined essentially by the sampled period, and crucially not by the ambient temperature or injection current (of course, a small difference frequency shift will appear due to fluctuations of temperature and injection current). Compared with conventional DMLs, this novel DML will have a stable THz repetition mode-beating frequency with a large working range in terms of the operating current of the device. Tuning the sampled period will tune the mode beating frequency to produce the THz radiation. We will use this DML as a practical compact, stable, solid-state laser source for generating THz radiation using the photoconductive antenna in our group and characterize the THz system using the best available room temperature THz detector Golay cell. The aims of this project are to: 1)Familiar with the measurement setup for THz signal using the EDFA and photoconductive antenna 2)Become familiar with THz signal using a room temperature THz detector Golay cell and lock-in amplifier 3)Know our existing MATLAB code to scan the DFB current and automatically measure the THz power 4)Become familiar with current-power, optical spectrum, far field pattern, and ultrafast (more than 500 GHz) signal measurements of semiconductor lasers. This project does not fall under export control because it repeats the work in our published paper "L. Hou, M. Haji, I. Eddie, H. L. Zhu, J. H. Marsh, "Laterally-coupled dual-grating distributed feedback lasers for generating mode-beat Terahertz signals," Opt. Lett., vol. 40, No.2, pp.182-185, 2015. DOI:10.1364/OL.40.000182".	Lianping Hou	2	1. L. Hou, M. Haji, I. Eddie, H. L. Zhu, J. H. Marsh, "Laterally-coupled dual-grating distributed feedback lasers for generating mode-beat Terahertz signals," Opt. Lett., vol. 40, No.2, pp.182-185, 2015. DOI:10.1364/OL.40.000182. 2. S. Tang, B. Hou, S. Liang, D. Chen, L. Hou, J.H. Marsh, "Terahertz Signal Generation Based on a Dual-Mode 1.5 µm DFB Semiconductor Laser," CLEO/PR 2018 Conference, Hongkong, China, oral presentation. 3.S. Tang, L. Hou, X. Chen, and J. H. Marsh, "Multiple-wavelength distributed-feedback laser arrays with high coupling coefficients and precise channel spacing," Opt. Lett., vol. 42, pp. 1800-1803, 2017

11	Frequency comb with 100 GHz spacing for 1 Terabits free space optical communications	Semiconductor mode-locked laser diodes (SMLLDs) are ideal coherent comb laser sources due to their compactness, mechanical stability, robustness, and broad gain spectrum. Optical frequency combs as a source of multiple spectral lines have been used in a variety of transmission system demonstrations, including long-reach systems with coherent detection, short-reach systems with direct detection, and passive optical networks. Such coherent comb lasers can reduce costs and simplify packaging issues by replacing many separate lasers for each channel with a single laser diode. Normally, quantum-dot or quantum dash SMLLDs have been used to produce coherent frequency combs, but the 1.55 µm SMLLDs based on InAs/InP quantum-dot materials are still relatively immature, suffer from lower modal gain, and have wider reported pulse widths than those of 1.55 µm multiple quantum well (MQW) SMLLDs. In this project, based on our MATLAB codes and mode locked software "Freetwm" to design the SMLLDs with a 100 GHz frequency comb spacing for 1 Terabits free space optical communications. For the coherent frequency comb, we will use AlGaInAs/InP asymmetric multiple quantum well (AMQW) passively mode-locked laser. AMQW lasers are MQW lasers with QWs of different thicknesses and (or) compositions within the same active region. QWs of different thicknesses and compositions generally emit at different wavelengths; thus, well-designed AMQW lasers are suitable for broadband applications, including the production of coherent frequency combs with a wider optical bandwidth. Device specifications: 1) 10 optical lines within -3-dB bandwidth 2) Wavelength: 1530-1625 nm(C and L band). 3) Wavelength spacing: 100 GHz 4) Average output power: >10 mW(single facet@25°C) 5) Pulse width < 450 fs 6) Optical linewidth: < 10 kHz 7) Timing jitter < 1 ps(10 kHz–100 MHz) 8) Operation temperature range: -40°C -85°C 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".	Lianping Hou	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
12	High-sensitivity optical biochemical sensor based on ring resonators	Biomedical detection sensors have wide applications in areas such as biomedical research, medical diagnostics, healthcare, and environmental monitoring. Label-free optical sensing is widely used as it is a relatively simple and low-cost approach compared with traditional label-based detection strategies. Conventional approaches require expensive instrumentation, time consuming analysis, and limited resolution. They are therefore far from being practical biomedical sensor systems with low unit cost, small form factor, low power consumption, high sensitivity and high selectivity are highly desirable. In this project, we propose to design a biomedical sensor based on silicon on insulator (SOI) photonic integrated circuit (PIC) technology. The sensor will consist of an input grating coupler, a micro-ring, and an output grating. The ring sensor will be laterally coupled to the bus waveguide via a narrow slot. By single mode fiber (SMF) light from the external tunable laser is vertically coupled into the input grating coupler, which is on the bus waveguide, which is coupled with the micro-ring. The output of the bus waveguide is connected to the output grating coupler. Another SMF is vertically coupled with the output grating coupler and connected to an optical spectrum analyzer. When the light satisfies the resonance condition in the micro-ring, the transmission from the bus waveguide shows a dip, i.e., the resonator behaves as a spectral filter. When the composition of the analyte (glucose or NaCl solution) surrounding the sensing ring changes, there is a corresponding change in the effective index of the micro-ring. This in turn changes the transmission behaviour of the light propagating in the micro-ring. From the optical spectrum response, a resonance wavelength shift can be detected. The aim of this project: 1)Simulate and optimize the input and output grating couplers and ring resonator dimension's structure based on the software of Rsoft/BeamPROP and Lumerical Finite Difference Time Domain (FDTD) solver. 2) Simulate the transmission behaviour of the light propagating in the micro-ring when changing the composition and concentration of the analyte(glucose or NaCl solution) (Using Lumerical FDTD solver). 3) Obtain the refractive index (RI) sensitivity in glucose or NaCl solution the limit of detection value 4)Familiar with the passive PIC devices' automatic measurement using Labview software This project does not fall under export control because it repeats the work in our published paper "W. Cheng, X. Sun, S. Ye, B. Yuan, J. Xiong, X. Liu, Y. Sun, J. H. Marsh, L. Hou, "Double slot micro ring resonators with inner wall angular gratings as ultra-sensitive biochemical sensors," Opt. Express, vol. 31, no. 12, pp. 20034- 20048, 2023."	Lianping Hou	2	W. Cheng, X. Sun, S. Ye, B. Yuan, J. Xiong, X. Liu, Y. Sun, J. H. Marsh, L. Hou, "Double slot micro ring resonators with inner wall angular gratings as ultra-sensitive biochemical sensors," Opt. Express, vol. 31, no. 12, pp. 20034- 20048, 2023
13	Internet through light: LiFi-based indoor IoT monitoring system	LiFi is an innovative technology that enables connecting to the Internet through LED or laser lights. It offers very high data rates and enhanced security for various IoT applications. The aim of this project is to utilize the existing LiFi equipment at UoG to connect IoT devices for environmental monitoring. The main task is to enhance the system performance by optimizing the placements of the LiFi transmitters and the IoT devices based on the LiFi transmission range and transmit power value. The achieved system can be tested under link blockage and user mobility in the coverage area to evaluate its robustness.	Hanaa Abumarshoud	2	- M. D. Soltani et al., "Terabit Indoor Laser-Based Wireless Communications: Lifi 2.0 For 6G," in IEEE Wireless Communications, vol. 30, no. 5, pp. 36-43, October 2023, doi: 10.1109/MWC.007.2300121. - B. G. Guzman et al., "Toward Sustainable Greenhouses Using Battery-Free LiFi-Enabled Internet of Things," in IEEE Communications Magazine, vol. 61, no. 5, pp. 129-135, May 2023, doi: 10.1109/MCOM.001.2200489.

14	Smart mirrors for enhanced LiFi connectivity	LiFi technology offers a green, cost-effective, and energy-efficient solution for Internet connectivity. It uses light signals for data transmission and modulation. One of the main challenges related to this technology is that light signals are susceptible to blockage by people or objects that happen to be in the light propagation path. An innovative solution is to use intelligent reflecting surfaces that are carefully placed and configured to steer the light towards the receiver. The aim of this project is to experiment the use of different reflecting materials and services to enhance the robustness of LiFi. The experimentation will use the LiFi test-bed that is available at the UoG.	Hanaa Abumarshoud	2	- M. D. Soltani et al., "Terabit Indoor Laser-Based Wireless Communications: Lifi 2.0 For 6G," in IEEE Wireless Communications, vol. 30, no. 5, pp. 36-43, October 2023, doi: 10.1109/MWC.007.2300121. - H. Abumarshoud, L. Mohjazi, O. A. Dobre, M. Di Renzo, M. A. Imran and H. Haas, "LiFi through Reconfigurable Intelligent Surfaces: A New Frontier for 6G?," in IEEE Vehicular Technology Magazine, vol. 17, no. 1, pp. 37-46, March 2022, doi: 10.1109/MVT.2021.3121647.
15	Animal welfare - from video to radar signatures	It is possible nowadays to emulate radar signatures from video files. In this project, we would like to study the fidelity of the produced radar signatures compared to the real measurements. You will modify the code to match the radar used in the experiments.	Julien Le Kernec	2	https://github.com/FIGLAB/Vid2Doppler
16	IoT-Based Environmental and Power Monitoring System	This project aims to develop an advanced embedded system that integrates multiple functionalities, including measuring AC/DC current through a clamp sensor, monitoring indoor temperature and humidity, and transmitting this data over LoRaWAN for centralised visualization on a real-time dashboard. The project will be divided into three main tasks, each assigned to a student. Task 1: Circuit Design The first task involves designing the overall circuit for the embedded system. Both students will collaborate on integrating the sensor interfaces, communication modules, and power management to create a cohesive and energy-efficient device. The focus will be on optimising the circuit for size, cost, and power consumption, ensuring the device's suitability for various deployment scenarios. Task 2: Sensor Interfacing and Data Collection The second task focuses on interfacing the clamp sensor for measuring AC/DC current and incorporating sensors for indoor temperature and humidity. One student will work on the sensor interfaces and data collection mechanisms. The goal is to ensure accurate and reliable data collection from these sensors through efficient data processing and calibration. Task 3: LoRaWAN Communication and Data Visualisation The third task involves developing the communication module to transmit data over LoRaWAN to a centralised location. The student will work on establishing a secure and robust communication protocol to ensure data integrity during transmission. Additionally, they will design and implement a real-time dashboard for visualising the collected data, providing a user-friendly interface for monitoring and analysis. Data will also be visualised on an onboard Oled display. Task 4: System Testing and Validation The fourth task focuses on testing and validating the entire system and both students will work on this. The clamp sensor's accuracy will be evaluated against off-the-shelf clamp meters, and the environment sensors will be validated against off-the-shelf environmental sensors. This task will involve statistical analysis of the data and the calculation of error in readings. The goal is to ensure that the developed system meets the required accuracy and reliability standards.	Ahmad Taha	2	https://docs.arduino.cc/learn/communication/wire/ https://docs.arduino.cc/learn/communication/spi/ https://docs.arduino.cc/learn/communication/low-power-wide-area-networks-101/ https://docs.arduino.cc/learn/communication/lorawan-101/
17	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.	Qingshen Jing	3	Recent progress of triboelectric nanogenerators: From fundamental theory to practical applications https://doi.org/10.1002/eom2.12059 https://onlinelibrary.wiley.com/doi/full/10.1002/eom2.12059 Recent Advances in Triboelectric Nanogenerators: From Technological Progress to Commercial Applications https://doi.org/10.1021/acsnano.2c12458 https://pubs.acs.org/doi/full/10.1021/acsnano.2c12458
18	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.	Qingshen Jing	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 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

19	Encoder and Decoder Design for Semantic Communication	his project aims to teach students the basic knowledge of how to train the learning model in wireless semantic communications, thus achieving a better encoding and decoding performance. The students will learn the key components of semantic communication, i.e., encoder and decoder, as well as some machine learning algorithms. Finally, the students will repeat an existing research work. All the papers, data and codes are from open sources.	Yao Sun	4	[1] 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. [2] 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. [3] C. E. Shannon, "A mathematical theory of communication," The Bell system technical journal, vol. 27, no. 3, pp. 379–423, 1948.
20	Basic semantic communication network design	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.	Yao Sun	4	[1] 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. [2] 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. [3] C. E. Shannon, "A mathematical theory of communication," The Bell system technical journal, vol. 27, no. 3, pp. 379–423, 1948.
21	Efficient Knowledge Base Update 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.	Yao Sun	3	[1] 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 [2] 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 [3] C. E. Shannon, "A mathematical theory of communication," The Bell system technical journal, vol. 27, no. 3, pp. 379–423, 1948
22	Photonic Electromagnetic modelling	The students will investigate open source electromagnetic simulation tools and use them to predict the performance of photonic structures and devices. Of particular interest is predicting the Purcell factor, which is asically the increase in spontaneous emissions due to the presence of a resonant structure. This has important applications areas such as lasing, optical sensing and photonic circuits.	Anthony Centeno	3	Krasnok, A., Slobozhanyuk, A., Simovski, C. et al. An antenna model for the Purcell effect. Sci Rep 5, 12956 (2015) https://doi.org/10.1038/srep12956 https://www.reddit.com/r/Physics/comments/z45cfp/can_someone_explain_the_purcell_effect_and_how/ https://www.cambridge.org/core/books/semiconductor-nanolasers/purcell-effect-and-the-evaluation-of-purcell-and-spontaneous-emission-factors/FE211A6D2C2574A9536AA82A24F9FBA6 https://meep.readthedocs.io/en/latest/Scheme_Tutorials/Local_Density_of_States/