Host Department: Department of Biomedical Engineering
(www.bioeng.nus.edu.sg)

BME 1

Project title	Development of an automated BioModel Selection System for Synthetic Biology Gene Circuit Design
Project description (for website) Note: - no more than 250 words	Synthetic biology, also known as the engineering of biology, involves programming of living biological systems using synthetic genetic circuits for a wide range of applications including engineering microbes to tackle infectious diseases, to produce high value chemical and to detect water contamination. Constructing a complex working gene circuit composed of different modular standardized biological parts to achieve the desired performance could be challenging without a proper understanding of how the individual modules behave. Mathematical modeling plays an important role towards better quantifying and optimizing the performance of the overall gene circuit, providing insights and guiding the design of experiments. As different gene circuits might require exclusively different mathematical representations, one of the key challenges in model development is the selection of the appropriate model. Such a process could be tedious and essentially involving prolonged iterative trial-and-error learning and testing cycles. To address this, the project aims to develop a software system using Python to automate the biomodel development and selection processes, providing a means to efficiently derive the best candidate model using characterization data from biological parts, and more complex gene circuits such as logic gates etc. Students involve in this project will have the opportunity to experience how genetic circuits are designed and characterized, and at the same time be trained to develop mathematical models using ordinary differential equations to describe and simulate simple gene circuits.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☒ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Biomedical Engineering, Electrical Engineering, Computer Science/Engineering, Chemical Engineering, System Engineering
What participants are expected	Developed a module of the software system which is able to take in a

to achieve at the end of the 8-week attachment - no more than 3 top outcomes	set of characterization data for a particular type of genetic circuits and output the model which best described the data.
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Assoc Prof Poh Chueh Loo http://www.bioeng.nus.edu.sg/people/PI/pohcl/
Name and address of lab that participants will be attached to	Engineering Biology Lab
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Programming skills (Python)

BME 2

Project title	Deep learning based motion control for minimally invasive surgery
Project description **(for website)** Note: - no more than 250 words	Medical data plays a significant role in image-guided diagnosis, intervention and planning; however, because of the high exposure radiation, it is not desirable for children, youth, pregnant females, etc. To address these challenges, the project aims to develop deep learning based statistical atlas and motion control. This involves medical image analysis and computational programming. For more information about our lab and our related previous projects, please visit: http://bioeng.nus.edu.sg/mm/ or http://bioeng.nus.edu.sg/mm/people/undergraduates/
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☒ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☒ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Computer Engineering and Biomedical Engineering
What participants are expected to achieve at the end of 8-week attachment	Learning skills useful for the future study
No. of participants able to host	1-2
Supervisor(s) - Please include link to online bio / research page	Dr. Hongliang REN For more information about our research projects, please click here (www.bioeng.nus.edu.sg/biomm)
Name and address of lab that participants will be attached to	Laboratory of Medical Mechatronics Faculty of Engineering, National University of Singapore, WS2-04-12, Engineering Workshop 2, No.1 Engineering Drive 3, Singapore, 117580
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	NA

BME 3

Project title	Modular Soft Locomotion Robots
Project description (for website) Note: - no more than 250 words	This project involves designing a modular robot for locomotion using already developed bending and torsional type actuators at the lab. The student will be provided with the basic designs and will be required to study their behavior and make some modifications for the application. The student is expected to then design an attachment to make the actuators link up with one another in form of a modular robot, that demonstrate locomotion in a variety of terrains.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Biomedical, Mechanical or Electrical and Electronics Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	• Develop skills in designing and fabricating soft robots from different soft materials • Learn techniques for control of modular robots • Conduct experiments to assess robot performance
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Dr. Raye Chen-Hua Yeow https://www.eng.nus.edu.sg/bme/staff/dr-yeowraye/ https://www.youtube.com/user/theeilab/videos
Name and address of lab that participants will be attached to	**Evolution Innovation Lab** Advanced Robotics Centre Blk E6, Level 7, 5 Engineering Drive 1 Singapore 117608
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Knowledge of biological locomotion such as crawling

BME 4

Project title	Wearable Soft Kinematic Sensors
Project description **(for website)** Note: - no more than 250 words	Biomechanical studies in sport are important to improve technique and performance as well as to prevent injuries. In this project, we will work on designing a wearable soft kinematic sensor system to study elbow and wrist joint angles. The sensor fabrication technique will be taught, and the student will be expected to come up with a custom shape and mounting for the sensor as per the application. The design will be influenced by the biomechanics of the sport (tentatively tennis) and the related motions. The device needs to provide low mechanical impedance to ensure that it does not impede training. Biomechanical knowledge will be utilized to create a multi sensor mounting to account of the multitude of movements at the given joints (such a pronation, radial and ulnar deviation at the wrist, elbow flexion etc.)
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☒ Design ☐ Product Development ☒ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Biomedical, Mechanical or Electrical and Electronics Engineering, with background or interest in Mechanical and or Biomechanics/ Sport
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	• Develop skills in signal processing and electronics design • Understand the constraints and requirements when designing wearable devices • Conduct trials to assess sensor capabilities
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Dr. Raye Chen-Hua Yeow https://www.eng.nus.edu.sg/bme/staff/dr-yeowraye/ https://www.youtube.com/user/theeilab/videos
Name and address of lab that participants will be attached to	**Evolution Innovation Lab** Advanced Robotics Centre Blk E6, Level 7, 5 Engineering Drive 1 Singapore 117608
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Knowledge of upper body biomechanics, and electronics

Host Departments: Department of Biomedical Engineering / Singapore Institute for Neurotechnology (SINAPSE) (www.bioeng.nus.edu.sg) / (http://www.sinapseinstitute.org/)

BME 5

Project title	Cognitive Engineering
Project description (for website) Note: - no more than 250 words	- Cognitive engineering program studies brain activity, mainly EEG and fMRI, for assessing cognitive function, workload, fatigue, attention and creativity (strong computing, algorithm, coding skills; machine learning/deep learning) - Cognitive function of Senses (odor, touch, vision) – our multimodality sensing and virtual reality lab tests sensory stimuli to assess how smell (pleasant, noxious), touch (light, palpation, pain) and vision (driving, flying) affect brain function (brain/senses; theory/computational and coding skills)
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☒ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Neuroscience, cognitive science, mathematics/statistics, computer science.
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	The participant should complete a well-defined project, submit a detailed report in a publication style (review, summary, results; documentation) and a presentation. Top students may strive to go for a conference or a journal publication. Others may complete the project to support the current graduate/post doc, and submit progress, documentation of methods, results, etc. Programs/prototoypes and demonstrations desirable.
No. of participants able to host	Up to 2 depending on match, capability and commitment
Supervisor(s) - Please include link to online bio / research page	Prof Nitish Thakor http://www.bioeng.nus.edu.sg/people/PI/Nitish/ http://www.sinapseinstitute.org
Name and address of lab that participants will be attached to	SINAPSE Institute, Center for Life Sciences, National University of Singapore 28 Medical Drive, Singapore 117456
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Strong computational and mathematical skills welcome. Interest in neuroscience/cognitive science desirable.

BME 6

Project title	Neurotechnology for Experimental/Clinical Translation
Project description **(for website)** Note: - no more than 250 words	In vitro and In vivo models of brain tumor and stroke. The idea is to study the origins of the disease, and different treatments. - The student will work with microfluidic, neuron on a chip to build neural network and neuron-muscle junction (microfluid and/or neurobiology background needed) - Conduct experiments with neurons, and brain cells to study the generation of tumors in an in vitro model of glioblastoma - Attend experiments on brain tumor (glioblastoma) and stroke, and assist with experimental data analysis and hypothesis testing
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Bioengineering, Neuroscience, Biology, Electrical and Computer Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	The participant should complete a well-defined project, submit a detailed report in a publication style (review, summary, results; documentation) and a presentation. Top students may strive to go for a conference or a journal publication. Others may complete the project to support the current graduate/post doc, and submit progress, documentation of methods, results, etc. Programs/prototoypes and demonstrations desirable.
No. of participants able to host	Up to 2 depending on match, capability and commitment
Supervisor(s) - Please include link to online bio / research page	Prof Nitish Thakor http://www.bioeng.nus.edu.sg/people/PI/Nitish/ http://www.sinapseinstitute.org
Name and address of lab that participants will be attached to	SINAPSE Institute, Center for Life Sciences, National University of Singapore 28 Medical Drive, Singapore 117456
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Wet lab skills, from cell culture to in vivo small animal studies Any experience with the experimental technology, e.g. optical or electrical recording, and data analysis desirable.

Summer Engineering Research Internship for US Students (SERIUS)

Host Department: Department of Civil & Environmental Engineering (http://www.eng.nus.edu.sg/cee/)

CEE 1

Project title	To examine the effect of Carbon Nanotubes (CNTs) with silver on the mixed bacterial biofilm formation and its application on wastewater treatment plant (WWTP)
Project description (for website) Note: - no more than 250 words	Opportunistic pathogens impose a great challenge because they establish and grow within drinking water system. Often the case, they will attach to a surface and enclose themselves with product of excretion by cells and cell death, thereby forming biofilm. One of the notorious properties of biofilm microbial communities is their inherent tolerances to antibiotics which causes it hard to be removed once formed. Any surface growth by microorganisms on the membrane in a water treatment facility, which is known as biofouling, will impair important processes.
	Silver nanomaterials, owing to their strong antimicrobial activity against a wide range of microbes as well as the low frequency of development of antimicrobial resistance, have been recognized by many industries. Ideally, the release of silver nanoparticles (Ag NPs) to reduce and the biofilm formation should be achieved in long run. As such, CNTs which are promising adsorbents for water treatment, have been chosen as carriers in which Ag NPs will be mixed with in this study.
	Student is required to:
	1) Synthesize CNTs mixed with Ag (ranging from Ag-decorated CNTs, Ag-doped CNT and etc.) as well as examine the effect of UV on the synthesis process
	2) Characterize the synthesized product using FESEM, XPS
	3) Conduct batch/ flow study experiment using the synthesized product on the biofilm formation (by Gram-ve, Gram+ve and mixed bacteria)
	4) Measure the Optical density (via spectrophotometer), Cultivability (via plate counting) and Viability (via Confocal Microscope) during the study
	5) Measure the morphology of the bacteria after the experiment via FESEM
	6) Measure the intracellular substance (e.g. leaked DNA and RNA) and reactive species via scavenger experiment
	7) Incorporate the best Ag-CNT (from the experiments) on the membranes for WWTP application
Nature of project (please click on the boxes to check	■ Laboratory Investigation ☐ Computing and Analysis

the relevant ones)	☐ Software Development ☐ Design
	☐ Product Development ☐ Field Testing and Instrumentation
	☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software)
	☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Environmental microbiology / Nanotechnology
What participants are expected to achieve at the end of 8-week attachment	After completing the project, the student is able to identify the most effective method of incorporating Ag into CNTs and the impact of this product on the bacterial biofilm formation. Besides, the student is able to understand the antimicrobial mechanism of the synthesized Ag-CNTs on the bacterial biofilm formation which is novel in the current field.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Asst Prof BAE Sung Woo http://cee.nus.edu.sg/people/ceebsw/
Name and address of lab that participants will be attached to	NA
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	NA

CEE 2

Project title	To examine the antimicrobial mechanism of Ag-doped carbon nanomaterials (CNMs) on the mixed bacterial biofilm formation
Project description **(for website)** Note: - no more than 250 words	Opportunistic pathogens impose a great challenge because they establish and grow within drinking water system. Often the case, they will attach to a surface and enclose themselves with product of excretion by cells and cell death, thereby forming biofilm. One of the notorious properties of biofilm microbial communities is their inherent tolerances to antibiotics which causes it hard to be removed once formed. Any surface growth by microorganisms on the membrane in a water treatment facility, which is known as biofouling, will impair important processes. Silver nanomaterials, owing to their strong antimicrobial activity against a wide range of microbes as well as the low frequency of development of antimicrobial resistance, have been recognized by many industries. Ideally, the release of silver nanoparticles (Ag NPs) to reduce and the biofilm formation should be achieved in long run. As such, carbon nanomaterials (CNMs) which are promising adsorbents for water treatment, have been chosen as carriers in which Ag NPs will be doped with the selected CNMs that are, graphene oxide (GO) and carbon nanotubes (CNTs) in this study. Student is required to: 1) Synthesize Ag-doped CNMs as well as examine the effect of UV on the synthesis process 2) Characterize the synthesized product using FESEM, XPS 3) Conduct batch/ flow study experiment using the synthesized product on the biofilm formation (by Gram-ve, Gram+ve and mixed bacteria) 4) Optical density (via spectrophotometer), Cultivability (via plate counting) and Viability (via Confocal Microscope) will be measured 5) Morphology of the bacteria after the experiment will be measured via FESEM 6) Measure the intracellular substance (e.g. leaked DNA and RNA) and reactive species via scavenger experiment 7) Measure the reactive oxidative species (ROS) and the gene expression during the study
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-	Environmental microbiology / Nanotechnology

disciplinary	
What participants are expected to achieve at the end of 8-week attachment	After completing the project, the student is able to understand fully on the antimicrobial mechanism of the Ag-doped CNMs on the biofilm formation, either from physical contact or through ROS manipulation. The study is novel as the antimicrobial effect of such material is well-known but the well-defined mechanism is lacking.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Asst Prof BAE Sung Woo http://cee.nus.edu.sg/people/ceebsw/
Name and address of lab that participants will be attached to	NA
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	NA

CEE 3

Project title	Combining ozonation and MBR processes for cost-effective organic matters removal in the phenolic wastewater
Project description (for website) Note: - no more than 250 words	Phenolic wastewater contains high levels of complex organics in terms of chemical oxygen demand (COD) in thousands mg·L^{-1}. The treatment of such industrial wastewater is especially challenging due to the inhibitory properties of recalcitrant organic pollutants. A widely recognized efficient treatment alternative for industrial wastewater containing recalcitrant compounds is the advanced oxidation processes (AOPs). However, AOPs for complete mineralization are generally expensive because the intermediates formed during treatment tend to be more resistant to complete chemical degradation. Furthermore, the intermediates also consume substantial amount of energy (radiation, ozone, etc.) and chemical reagents (catalysts and oxidizers) which increase with treatment time. To design the process for the best overall economic and treatment performance, AOP coupled with biological process was proposed to enhance cost-effectiveness by minimizing the cost of AOP treatment and maximizing the efficiency of biological treatment process. In this study, membrane bioreactor (MBR) was used as a subsequent process to treat the ozonation pre-treated phenolic wastewater. The ozonation was used for the purpose of COD reduction and biodegradability improvement. The MBR was adopted to achieve further COD reduction in phenolic wastewater with low cost. The objective of this study is to conduct process optimization for the MBR system and to monitor its performance under optimum operating conditions. Results of this study will be used for pilot-scale system design.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Environmental Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Understand a cost-effective process for industrial wastewater treatment Evaluate the process performance
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Prof. Hu Jiangyong

Name and address of lab that participants will be attached to	E8, Water Science and Technology Lab
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	NA

CEE 4

Project title	Inhibitory characters of antibiotics (SMX/TMP) on AOB, NOB and DB, and their enhanced degradation by Fe(0)-loaded BAC
Project description (for website) Note: - no more than 250 words	The most commonly used drugs for the treatment of infectious diseases are antibiotics. Sulfamethoxazole (SMX) and trimethoprim (TMP) are usually prescribed together in veterinary and human medical treatment for respiratory, urinal, and gastrointestinal diseases. Both antibiotics have been identified as emerging contaminants and have been found in underground and superficial water resources, as well as in the effluents of hospitals and municipal wastewater treatment plants at concentrations ranging from $ng\cdot L^{-1}$ to $\mu g\cdot L^{-1}$. While in the livestock wastewaters and anaerobic digestion concentrate, their concentrations could rich $mg\cdot L^{-1}$. These concentrations of SMX and TMP would show various inhibitory effects to the functional bacteria, e.g. the ammonia oxidizing bacteria (AOB), nitrite oxidizing bacteria (NOB), and denitrifying bacteria (DB), which would affect the performance of wastewater treatment process.

Advanced oxidation processes (AOPs) have been recognized an efficient technology for antibiotics degradation. However, the AOPs for compounds mineralization are usually expensive for the consumption of substantial amount of energy (radiation, ozone, etc.) and chemical reagents (catalysts and oxidizers). To design the process for the best overall economic, biological process was proposed to enhance cost-effectiveness by minimizing the utilization of AOP process and maximizing the efficiency of biological treatment process.

In this study, the inhibitory characters of SMX and TMP on the AOB, NOB and DB in wastewater treatment were investigated in the biological activated carbon (AC) system (BAC). On this basis, the Fe(0)-loaded BAC was set up to enhance the SMX and TMP removal with a combination between the oxygen radical production from the Fe(0)-AC galvanic-cells and the biological degradation. This study is aimed to have an in-depth understanding on the inhibition characteristics of SMX and TMP onto the functional microorganisms in wastewater treatment, and provide a potential biological system for their effective degradation associated with nutrient removal. |
| **Nature of project** (please click on the boxes to check the relevant ones) | ☒ Laboratory Investigation ☐ Computing and Analysis
 ☐ Software Development ☐ Design
 ☐ Product Development ☐ Field Testing and Instrumentation
 ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software)
 ☐ Others: _____ |
| **Relevant majors** - you may indicate more than one, especially if project is cross-disciplinary | Environmental Engineering |

What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Understand a biological process for water and wastewater treatment Evaluate the inhibitory effects on process performance
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Prof. Hu Jiangyong
Name and address of lab that participants will be attached to	E8, Water Science and Technology Lab
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	NA

CEE 5

Project title	3D Underground Pipe Layout planning
Project description **(for website)** Note: - no more than 250 words	The presence of underground utilities such as pipes and sewers are a common cause of construction issues. Current methods to plan the laying of such utilities is conducted manually, and is highly inefficient. Uncertainty of the pipe locations is also a major factor. The objective of this project is to explore robotic path planning techniques to automate underground pipe planning to facilitate construction applications.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Civil Engineering, Computer Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	1. A literature review of underground utilities planning techniques 2. Develop an algorithm to determine the optimal pipe layout
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Dr Justin Yeoh https://www.eng.nus.edu.sg/cee/staff/yeoh-ker-wei-justin/
Name and address of lab that participants will be attached to	
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Programming skills Understanding of uncertainty quantification/ probabilities

CEE 6

Project title	Quantification of effectiveness of deep learning methods for building façade defects
Project description**(for website)**Note:- no more than 250 words	Building façade defects are a major problem in our aging districts. Early detection and identification will allow engineers to proactively address potential safety issues. Various deep learning methods have been proposed by researchers, and the purpose of this project is to take stock of these methods to determine their relative effectiveness.
Nature of project(please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors- you may indicate more than one, especially if project is cross-disciplinary	Civil Engineering, Computer Engineering
What participants are expected to achieve at the end of the 8-week attachment- no more than 3 top outcomes	1. A literature review of deep learning methods used for building façade defects. 2. Compare and contrast the various deep learning methods, as well as their effectiveness, for the various types of defects.
No. of participants able to host	2
Supervisor(s)- Please include link to online bio / research page	Dr Justin Yeoh https://www.eng.nus.edu.sg/cee/staff/yeoh-ker-wei-justin/
Name and address of lab that participants will be attached to	
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Programming skills (Python and tensorflow (or related libraries)) Understanding of deep learning and computer vision techniques will be a bonus. Understanding of building defects is not necessary, but will also be a bonus.

CEE 7

Project title	Extracting geological information from urban traffic noise using machine learning
Project description (for website) Note: - no more than 250 words	Urban traffic noise has been harvested in order to map out the bedrock depth in Singapore based on physical concepts. In this project, a machine learning approach will be experimented to perform the same task. Participant of this project will learn the relationship between ambient traffic noise and underground geology, generate simulated data, train a neural net, and apply it on field data.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☒ Software Development ☐ Design ☐ Product Development ☒ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Civil engineering; Geophysics; Data science; Computer science
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	* Understanding of underground wave propagation * Neural network construction and training * Field experiences in data acquisition and processing
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Dr. Yunyue Elita Li Personal page: https://www.eng.nus.edu.sg/cee/staff/li-yunyue-elita/ Group information: http://sgpnus.org/index.html
Name and address of lab that participants will be attached to	Singapore Geophysics Project
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Applicants with programming and/or field experiences are preferred

NUS
National University
of Singapore

Faculty of Engineering

Host Department: Department of Chemical & Biomolecular Engineering (www.chbe.nus.edu.sg)

CHBE 1

Project title	Converting food waste into energy and resources through biological processes
Project description (for website) Note: - no more than 250 words	As the world's population continues to rise, the need for sustainability is becoming more and more pressing. Two key areas of concern involve finding new, less polluting sources of energy and an effective waste management strategy. It is here that anaerobic digestion can provide a simultaneous, sustainable solution to both challenges. The methane-rich biogas generated is suitable for energy production and can replace fossil fuels. Some substrates, such as food waste, have especially high biogas yields. While it is not energy-efficient to burn food waste because of its high moisture content that requires high energy for incineration, it is ideal for anaerobic digestion as it contains an abundance of organic material that is a valuable biomass resource for the anaerobic digestion process.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation　☐ Computing and Analysis ☐ Software Development　☐ Design ☐ Product Development　☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies　☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Chemical engineering, Environmental engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	- to understand about wastes and sustainability - to be able to link chemical engineering with biology and environment
No. of participants able to host	3
Supervisor(s) - Please include link to online bio / research page	Assoc Prof Tong Yen Wah http://cheed.nus.edu.sg/stf/chetyw
Name and address of lab that participants will be attached to	E2S2-CREATE, 1 CREATE Way, University Town, NUS
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	No

CHBE 2

Project title	Convert CO$_2$ into fuels and chemicals
Project description **(for website)** Note: - no more than 250 words	The target of this project is to identify improved catalyst to promote the transformation from CO$_2$ to higher value chemicals and fuels such as formic acid and methanol. Sol-gel processes, template-assisted syntheses and dry-chemistry approaches will be used to prepare atomically dispersed catalysts on substrate. Automation based synthetic strategies for catalyst preparation will be employed as a complement to human labor and intelligence, which will also help to enhance the success rate in catalyst screening. The performance of the heterogeneous catalysts to convert CO$_2$ to methanol/formic acid will be evaluated in a high-pressure flow reactor, to prove whether these new catalysts are indeed highly promising in CO$_2$ hydrogenation. Kinetic studies will be conducted to unravel activation energies, reaction orders and rate constants, sheding light on the reaction mechanism.
SNature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Chemistry; Chemical Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	1) Basic synthetic procedures for catalyst preparation; 2) Operation and product analysis for high pressure flow/batch reactors; 3) Analytical tools to characterize catalysts.
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Assoc Prof Yan Ning https://yan-nus.weebly.com/
Name and address of lab that participants will be attached to	Lab of Green Catalysis; E8, Level 6
Any other information/ requirements	Nil.

CHBE 3

Project title	Polymer-Coated MOFs for Water-Resistant CO_2 Capture
Project description (for website) Note: - no more than 250 words	Separation of CO_2 from post-combustion flue gas is an important approach to achieve carbon-neutral economic development. The development of adsorbent materials with suitable properties for this separation, in particular, appropriate microporosity and compatibility with water, are required to attain performance levels sufficient to replace incumbent technologies such as amine scrubbing. Of these, metal-organic frameworks (MOFs) possess highly tunable structures amenable to design and currently claim benchmark performances in this separation. However, those materials face certain challenges in scaling-up. In this project, we aim to optimize polymer coating strategies to prepare water-resistant adsorbents based on high-performing MOF materials. The student will be exposed to the MOF fabrication and post-synthetic modification process, as well as the characterization and performance evaluation of those materials in CO_2 capture.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Chemistry, Chemical Engineering, Materials Science and Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	The synthesis and activation of metal-organic frameworks The polymer coating processes The static and dynamic sorption experiments
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Assoc Prof Dan ZHAO http://cheed.nus.edu.sg/stf/chezhao/home.html
Name and address of lab that participants will be attached to	Advanced Porous Materials and Membranes 1 Engineering Drive 3, Blk WS2 #05-16, Singapore, 117580
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	N.A.

Faculty of Engineering

Host Department: Department of Electrical & Computer Engineering (www.ece.nus.edu.sg)

ECE 1

Project title	Mobile Vital Signs Monitoring System
Project description (for website) Note: - no more than 250 words	One of the limitations of current vital signs monitoring system is that the user is usually limited to movement within a room or the gateway is on-body. In this project, we will look at different ways to develop a truly mobile vital signs monitoring system. We will also explore the application of machine learning algorithms to detect various medical conditions. You will join a team of engineers and fellow students to work on different parts of the project: database, server, mobile apps, localization algorithms, etc depending on your interest.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☒ Software Development ☐ Design ☒ Product Development ☒ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Signal Processing, Computer Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	1. Good literature review of the problem. 2. Data collection and analysis. 3. Detailed documentation and report.
No. of participants able to host	3
Supervisor(s) - Please include link to online bio / research page	Assoc Prof Arthur Tay
Name and address of lab that participants will be attached to	Advanced Control Technology Lab E4-08-22
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Comfortable with programming, embedded systems.

ECE 2

Project title	Wireless sensing sutures for *in situ* monitoring of surgical site for post-surgical complications
Project description (for website) Note: - no more than 250 words	Surgeries are operational procedures performed to treat ailments. Despite careful surgical technique, surgeries, especially gastrointestinal surgeries are susceptible to post-surgical complications like bleeding, infection and suture breakage. 75% of post-operative complications occur 14 days post-surgery. The symptoms are felt too late for early clinical interventions and require expensive imaging techniques by trained clinicians.Therefore there is a clinical need for *in situ* and real-time methods to monitor post-surgical complications to mitigate the severity and costs. Owing to their intimate contact with the surgical site, sutures which are used to appose tissue and facilitate wound healing, have been used as attractive platform for integrating therapeutic diagnostic functionalities beyond their basic mechanical function. But these 'suture-based' monitoring devices have material properties completely different from current medical grade sutures and rely on wired connections to readout electronics. We have developed and demonstrated a class of wireless sensing (WISE) sutures with medical grade pliability and biocompatibility for continuous monitoring of post-surgical complications like bleeding, infection and compromise in suture integrity. WISE sutures compromise of conductive sutures which act as antenna and on-board microsensors. To further our work, the project involves the use of WISE sutures to be used in nerve stimulation and repair, wirelessly powered drug delivery and sensing of surgical site. The project also involves the integration of antenna to microsensor as a TAG, for ease of translation of technology and commercialization.
Nature of project (please click on the boxes to check the relevant ones)	✓ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ✓ Design ✓ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	- Electrical and Computer Engineering - Biomedical Engineering - Materials Science and Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Testing WISE sutures for nerve stimulation Design of and testing of TAG
No. of participants able to host	1
Supervisor(s)	Supervisor: Dr. John S. HO

- Please include link to online bio / research page	Co-Supervisor: Dr. Viveka KALIDASAN https://www.ece.nus.edu.sg/stfpage/hsyj/people.html
Name and address of lab that participants will be attached to	Wireless Bioelectronics Lab, Electrical and Computer Engineering, National University of Singapore.
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	

ECE 3

Project title	Wearable wireless biomolecular sensors
Project description (for website) Note: - no more than 250 words	Over the past decades, the study on biosensor has been continuously advanced for facile and non-invasive operation. The emerging sensors based on wireless technique have enabled the continuous readout of the biomolecule from body fluids, such as sweat, tear and saliva. From the perspective of sensing mechanisms, there are different electrical biosensors, from chemiresistors, field-effect transistors to electrochemical sensors. This project will investigate the usage of low dimension materials as the biosensor at diverse locations, such as ocular and skin surfaces, which will not only benefit this sensor system but also inspire more wireless wearable/implantable biosensors.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☑ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Materials Science and Engineering, Chemical Engineering, Biomedical Engineering, Electrical Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	1. Study various simulation tools for antenna and RF circuit 2. Study the mechanisms for representative biosensing
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Dr. John S. Ho https://www.ece.nus.edu.sg/stfpage/hsyj/people.html
Name and address of lab that participants will be attached to	The N.1 Institute for Health, Centre for Life Sciences, 28 Medical Drive, #05-COR, Singapore 117456
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Data Analysis, PCB layout

ECE 4

Project title	Automatic Leaderboard for Singing Quality Assessment
Project description (for website) Note: - no more than 250 words	Singing is a popular medium of entertainment. Unfortunately, singing pedagogy remains heavily dependent on human music experts, who are few in number. Singing quality assessment often refers to the degree to which a particular singing vocal production meets professional standards of excellence. For reliable assessment, it is important to identify vocal attributes that relate to human perceptual ratings and objectively appreciate singing excellence. The previous studies for objective characterization of singing quality have focused on pitch, rhythm, vibrato, and timbre features. The aim of this project is to develop neural network based algorithm for automatic singing quality evaluation, in both reference-independent and dependent scenarios. The neural algorithm marks a departure from the hand-crafted features, that is expected to learn the objective characteristics of singing quality automatically, and greatly improve the state-of-the-art automatic evaluation performance. The study will be conducted on an existing singing quality evaluation platform in the National University of Singapore.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☒ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Computer engineering, computer science
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	- review the literature of singing quality evaluation - implement one end-to-end framework for automatic singing evaluation
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Professor Haizhou Li
Name and address of lab that participants will be attached to	E4-06-20, Human Language Technology Lab, Dept of Electrical and Computer Engineering, NUS
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Basic programming skills, experience with Python, pytorch, tensorflow is a plus

ECE 5

Project title	Image based Defect Identification during Manufacturing Processes
Project description **(for website)** Note: - no more than 250 words	As we move towards the future and Industry 4.0, there is a large push towards automating all areas of manufacturing. A major component of that is identifying manufacturing faults during the process itself and responding to them quickly and precisely. In this project, we will be looking at data from product manufacturing lines, which could include visual, text or numerical data. Visual data could be in the format of videos or images, and can be used for fault identification such as cracks/scores on surfaces, damages due to handling etc. Text data such as maintenance logs, and numerical data including manufacturing machine and environmental sensor outputs, could be used to supplement the visual data for defect identification and anomaly prediction. As the data might be sourced from real-world settings, it would be very difficult to use supervised methods of classification due to the unavailability of fully labeled data. Semi-supervised learning, as well as on-line learning techniques can be used to fill the gap here. Graph-based methods, auto-encoders and generative models have proven successful in the past for dealing with the semi-supervised learning problems such as image classification, speech recognition etc. These can be further explored for the purposes of this project.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☒ Software Development ☐ Design ☒ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical Engineering, Computer Engineering, Computer Science
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	1) Explore machine learning models, especially those dealing with semi-supervised learning, and imbalanced datasets. 2) Understand and deploy image-based classification algorithms, including but not limited to deep learning methods. 3) Apply one or more of the models to create a robust quality estimation tool.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Assoc. Prof. Prahlad Vadakkepat https://www.eng.nus.edu.sg/ece/staff/prahlad-vadakkepat/
Name and address of lab that participants will be attached to	**Mechatronics & Automation Laboratory** Department of Electrical and Computer Engineering Block E4A, Level 3, Room 4 3 Engineering Drive 3

	Singapore 117582 National University of Singapore
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	1) Experience with/willingness to learn OpenCV and other image processing tools. 2) Basic knowledge of machine learning architectures. 3) Experience with python preferred.

ECE 6

Project title	Path tracking control design for autonomous agricultural robot
Project description (for website) Note: - no more than 250 words	With the rapid development of navigation and control techniques, the agricultural robot has gradually become highly automated and intelligent, which is the basic platform for precision agriculture. Automation would increase considerably the productivity by increasing efficiency, reliability and precision, and reducing the need for human intervention. In addition, it can reduce the production costs, fuel consumption and air pollution. One of the most fundamental issues related to automation is the path tracking problem, which enables the vehicle to reach and follow a predefined path that is not parameterized by time. In this project, students are expected to design and develop controller for agricultural robot by working together with our group. During the project, students are expected to strengthen the abilities of self-motivated study, project planning, algorithm development, system integration, and academic writing.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Control Science, Computing and analysis, Optimization
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	A software systems that can control the agricultural robot to track specific paths.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Prof. Shuzhi Sam Ge https://robotics.nus.edu.sg/sge/
Name and address of lab that participants will be attached to	Robotics Research Laboratory
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Unity, Python, Signal Processing, Control Science

ECE 7

Project title	The design and control allocation of a novel fully actuated tilting quadcopter
Project description (for website) Note: - no more than 250 words	Unmanned aerial vehicles (UAVs) have seen a boost in popularity and been an active research topic for both military and civil applications, especially the quadcopter. Developing omni-directional vehicles becomes increasingly significant to improve their performance in various tasks. In this project, students are expected to design and develop controller for this novel vehicle to achieve its controllability over 6 DOF by working together with our group. During the project, students are expected to strengthen the abilities of self-motivated study, project planning , algorithm development, system integration, and academic writing.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Control Science, Computing and analysis, Optimzation
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	A software systems that can control the novel tilting quadcopter to track arbitrary trajectories in space.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Prof. Shuzhi Sam Ge https://robotics.nus.edu.sg/sge/
Name and address of lab that participants will be attached to	Robotics Research Laboratory
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Python, Signal Processing, Control Science

ECE 8

Project title	Develop digital twin of interacting systems in complex sea scenarios
Project description (for website) Note: - no more than 250 words	In offshore operations such as FLNG offloading or rig installation, the environment envelopes are very conservative due to the high risks of explosions and environmental pollution. Operators are interested to enhance the productivity of the offshore assets through better understanding and predictability of the global performance of the coupled systems, predictability of operations and active control strategies.
	In this project, students are expected to design and develop digital-twin for Offshore operations to achieve its controllability and predictability by working together with our group. During the project, students are expected to strengthen the abilities of self-motivated study, project planning , algorithm development, system integration, and academic writing.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Control Science, Computing and analysis, Optimzation
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	An operation advisory system Graphical User Interface (GUI) and on-board edge computing can be built up for operational advisories.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Prof. Shuzhi Sam Ge https://robotics.nus.edu.sg/sge/
Name and address of lab that participants will be attached to	Robotics Research Laboratory
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Python, Matlab, Control Science

ECE 9

Project title	In-situ magnetic force microscope setup for magnetic domain study
Project description (for website) Note: - no more than 250 words	Most magnetic force microscopes (MFM) work by using a high resolution probe to scan a sample of its magnetic domains at the nanoscale. The characterization allows one to study the remnant states of magnetic domains after the field applications and map domain configuration changes at appropriate field intervals. However, a lack of *in-situ* field application in the system does NOT allow the *in-situ* magnetic domain of nanostructures to be measured. The information given by *in-situ* magnetic domain is valuable in understanding how the magnetic domains relax as field is removed. This project aims to improve the operation of current MFM by designing a field application module (set-up) to create a uniform magnetizing field on the sample during the measurement. The module is to be attached to the MFM. The field application module will have the capability of sweeping the field in small step size from one direction to the opposite direction. This will allow a better understanding on how magnetic domains nucleate, propagate and annihilate at different field values. In this project, the student will work closely with our research group to design and create the in-situ MFM setup which can be used for real time magnetic domain study. If time permits, the student will utilize this new set-up to characterize different novel magnetic structures.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☒ Design ☐ Product Development ☒ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical Engineering or Mechanical Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	- Design an in situ magnetizing field setup - Create the in-situ MFM system and test it.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	A/P Vivian Ng https://www.eng.nus.edu.sg/ece/staff/vivian-ng/
Name and address of lab that participants will be attached to	ISML (E6-Level 2, Engineering, NUS), 5 Engineering Drive 1, Singapore 117608
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Basic knowledge on magnetism. Electromagnet design and knowledge on permanent magnets is a plus. Experience with nanotechnology is another plus.

ECE 10

Project title	Skyrmionic devices for future computing schemes
Project description (for website) Note: - no more than 250 words	Skyrmion is a new spintronic phenomenon that can implement futuristic computing schemes such as the bio-inspired neuromorphic computing. We recently explored a new phenomenon that uses spin waves as a medium for interaction between spin-torque oscillators, which can lead to a more efficient neuromorphic computing hardware architecture. In this project, we will use micromagnetic simulations to further explore the phenomenon and leverage skyrmions to implement novel electronic device behavior. Students are expected to develop methodologies to evaluate the use of their proposed device structures in new circuits, and validate their ideas.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Physics, Computing Engineering, Electrical Engineering, Materials Science & Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	- Develop a micromagnetic simulation framework for evaluating the proposed skyrmionic device concepts - Evaluate one scheme that utilizes the proposed skyrmionics device concept for machine learning
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Dr Kelvin FONG Xuanyao https://blog.nus.edu.sg/seeder https://blog.nus.edu.sg/kelvinxyfong
Name and address of lab that participants will be attached to	Computational Nanoelectronics & Nanodevices Laboratory 4 Engineering Drive 3, E4-07-12, Singapore 117583
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Knowledge of Python and MATLAB

ECE 11

Project title	Design of multi-port non-volatile embedded memories
Project description (for website) Note: - no more than 250 words	Non-volatile memory technologies such as spin-transfer torque magnetic RAM (STT MRAM) have the capability for ultrafast write operations as fast as SRAM. However, requirements to achieve such fast write speeds either lead to extremely high write energy consumption or breakdown and failure of the memory device. Hence, the write performance is sacrificed to maintain device reliability and keep write energy within acceptable bounds. However, multi-port designs avoid issues with write operations blocking accesses to the rest of the memory array. Thus, the memory can service access requests at much faster speeds than the write performance. In this project, students are expected to learn about the operation of STT MRAM as well as future genres of MRAM (such as spin-orbit torque MRAM and voltage-controlled MRAM). We will then develop multi-ported designs based on these memory technologies, and evaluate their energy consumption, performance, and suitability for embedded memory applications.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical Engineering, Computer Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	- Proposed a design of spin-orbit torque or voltage-controlled MRAM bitcell - Developed circuit model for the proposed bitcell - Detailed analysis and evaluation of the proposed bitcell
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Dr Kelvin FONG Xuanyao https://blog.nus.edu.sg/seeder https://blog.nus.edu.sg/kelvinxyfong
Name and address of lab that participants will be attached to	Computational Nanoelectronics & Nanodevices Laboratory 4 Engineering Drive 3, E4-07-12, Singapore 117583
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Familiarity with SPICE simulations, and analog and digital circuit concepts (e.g., opamps, logic gates, etc.)

ECE 12

Project title	Design of non-volatile in-memory processor
Project description (for website) Note: - no more than 250 words	Future Cognitive Internet of Things will deploy machine learning and artificial intelligence algorithms on edge devices for various applications. However, the hardware architecture needs to drastically reduce the energy consumption of the hardware that will be executing these algorithms so as to meet the unique energy requirements. In-memory processing techniques have emerged as a promising solution. In this project, students will be involved in the design of an in-memory processing unit based on non-volatile memory devices (e.g. ferroelectric RAM, ReRAM, STT MRAM and SOT MRAM).
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical Engineering, Computer Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	- Propose an in-memory processing unit based on a non-volatile memory device - Develop simulation models for the proposed non-volatile in-memory processing unit - Evaluate the proposed in-memory processing unit
No. of participants able to host	4
Supervisor(s) - Please include link to online bio / research page	Dr Kelvin FONG Xuanyao https://blog.nus.edu.sg/seeder https://blog.nus.edu.sg/kelvinxyfong
Name and address of lab that participants will be attached to	Computational Nanoelectronics & Nanodevices Laboratory 4 Engineering Drive 3, E4-07-12, Singapore 117583
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Knowledge of Python and MATLAB Familiarity with concepts of memory subsystems

Summer Engineering Research Internship for US Students (SERIUS)

Host Department: Innovation & Design Programme (https://www.eng.nus.edu.sg/idp/)

IDP 1

Project title	Modelling changeability of complex engineering systems
Project description (for website) Note: - no more than 250 words	It is widely accepted that complex engineering systems are often designed through modifications of existing ones. Such an approach can facilitate the reuse of components and knowledge from previous designs. However, it is documented that changes initially perceived as simple can sometimes propagate undesirably, resulting in costly delays. Hence, modelling approaches have been developed to support the management of engineering change propagation in design projects and across life cycle of products and systems. While efforts have been made to discuss how change analysis results can be affected by model granularity and the types of change data used, few studies discuss how change analysis results can be affected by the way system boundaries are defined. System boundary decisions are especially important in change propagation analysis as engineering change can in reality propagate out of the system modelled and back through components that were not considered. This project aims to examine the effect described above through case study analysis.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☒ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	System Engineering, Mechanical Engineering,
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	A report on the design of experiments (modelling setups), modelling results, and recommendations.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Dr Edwin Koh http://www.eng.nus.edu.sg/edic/staff_profile_edwin_koh.html
Name and address of lab that participants will be attached to	Engineering Design and Innovation Centre (EDIC) Blk E2A, #04-05, 5 Engineering Drive 2, S(117576)

Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Programming skills an advantage.

IDP 2

Project title	Personalizing drug dosages through 3D printing
Project description (for website) Note: - no more than 250 words	The dosage of a drug required to treat an ailment depends on many factors such as age and weight of a patient, severity of the condition, and potency of the drug. However, drug tablets sold in clinics, hospitals and pharmacies typically come in standard dosages. This makes it difficult for doctors and pharmacists to prescribe the precise dosage that is required for each patient. Hence, it leads to problems such as less-than-ideal duration between dosages or the need for patients to break large tablets into smaller doses that are neither definite nor predictable. The development of various 3D printing technologies over the past decade has opened up many new possibilities to address this problem. There is now a tremendous potential to customize drug dosages for individual patients instead of relying of pre-packed dosages. Moreover, 3D printing of drug tablets may also improve the absorption process which could improve the effectiveness of a drug. The United States Food and Drug Administration recently approved an epilepsy drug that is made by 3D printing. Current players in this field believe that it is possible to commercialize 3D printed drug tables within the next 5 to 10 years. The aim of this project is to develop a 3D printing system that is capable of customizing drug combinations and dosages according to the needs of individual patients in a precise, efficient, and reliable manner. The system should be designed for use in clinics, hospitals and pharmacies to dispense common drugs. This project is a continuation of an existing student project, and its scope may include designing, building, and testing a prototype of the 3D printing system.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☒ Design ☒ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Biomedical Engineering Chemical Engineering Electrical Engineering Engineering Science Materials Science & Engineering Mechanical Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Students may propose and prototype a new design concept, or focus on improving and optimizing an existing solution.
No. of participants able to host	2

Supervisor(s) - Please include link to online bio / research page	Dr Elliot LAW (https://www.eng.nus.edu.sg/idp/staff/elliot-law/) Mr Eugene EE (https://www.eng.nus.edu.sg/idp/staff/eugene-ee/) Prof Paul HO (http://pharmacy.nus.edu.sg/profile_paulho/)
Name and address of lab that participants will be attached to	Engineering Design & Innovation Centre Block E2A #04-05 5 Engineering Drive 2 Singapore 117579
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Students who are keen to work on this project should have decent hands-on prototyping skills. Prior experience with microcontroller programming (e.g. Arduino, Raspberry Pi), 3D printing, and simple computer-aided design software (e.g. SolidWorks, Autodesk) would be advantageous, although students can pick up these skills as they work on the project. Due to the multi-disciplinary nature of the work (involving biomedical, chemical, electrical, and mechanical issues), students should be open to working on aspects that may be beyond their own Engineering discipline.

IDP 3

Project title	Autonomous defects detection in construction
Project description (for website) Note: - no more than 250 words	Quality and defects are major issues in the construction industry and typically cause substantial delays in handing over a building to its owners. Some of the most common defects is that of detecting surface levelness and flatness of floors and walls. This is a time consuming and laborious task that is ripe for disruption. Current methods of checking these either involve a lot of manpower, or sophisticated and expensive technology. The use of tiles and other architectural finishes on the floors and walls makes this task even more challenging. The project objective is to investigate and develop an autonomous method of detecting: (a) if a surface is level, (b) if a surface is flant, and (c) which regions of the surface are quality defects. This project is a continuation of an existing student project, and its scope may include designing, building, and testing a prototype of the design solution.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☒ Software Development ☒ Design ☒ Product Development ☒ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Computer Engineering Electrical Engineering Engineering Science Mechanical Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Students may propose and prototype a new design concept, or focus on improving and optimizing an existing solution.
No. of participants able to host	3
Supervisor(s) - Please include link to online bio / research page	Dr Elliot LAW (https://www.eng.nus.edu.sg/idp/staff/elliot-law/) Mr Eugene EE (https://www.eng.nus.edu.sg/idp/staff/eugene-ee/) Mr Brian Shohei TEO (https://www.eng.nus.edu.sg/idp/staff/teo-shohei-brian/)
Name and address of lab that participants will be attached to	Engineering Design & Innovation Centre Block E2A #04-05 5 Engineering Drive 2 Singapore 117579
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Students who are keen to work on this project should have decent hands-on prototyping skills. Prior experience with microcontroller programming (e.g. Arduino, Raspberry Pi), 3D printing, and simple computer-aided design software (e.g. SolidWorks, Autodesk) would be advantageous, although students can pick up these skills as they work on the project.

	Due to the multi-disciplinary nature of the work (involving computing, electrical, and mechanical issues), students should be open to working on aspects that may be beyond their own Engineering discipline.

IDP 4

Project title	Development of a Web-Based Virtual Reality System
Project description (for website) Note: - no more than 250 words	This project aims to develop a web-based system virtual reality (VR) wearable systems to be used for team collaboration using web hosting apps (e.g. Zoom) and VR headgear. There are many different tools available for such purposes. But the effective use of such tools for team collaboration is not guaranteed. The developed VR system should be relatively easy to adopt, produce more reliable results (in part through provision of real-time feedback on team's performance) as compared to current offerings. Ultimately, it is envisaged that this project will translate into more practical applications to allow teams to effectively collaborate. This project involves software development.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☒ Software Development ☒ Design ☒ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical and Computer Engineering, Mechanical and Product Development Engineering
What participants are expected to achieve at the end of 8-week attachment	Proof-of-concept development for the proposed approach
No. of participants able to host	4
Supervisor(s) - Please include link to online bio / research page	Dr Tang Kok Zuea
Name and address of lab that participants will be attached to	Engineering Design and Innovation Centre (EDIC), Innovation and Design, Faculty of Engineering, Block E2A, #04-05, 5 Engineering Drive 2, Singapore 117579
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	No.

IDP 5

Project title	Surgical Tool Checker using Deep Learning and Smart Vision
Project description **(for website)** Note: - no more than 250 words	An article in the Outpatient Surgery magazine has written that an instrument processing department in the US has to process 900 trays of instrument per day. Due to this high volume of surgical tools, hospitals are facing a challenge of reducing the number of missing tools in their inventory as well as incomplete surgical sets in operation theatre. The problem also lies on the close similarities between 2 different tools, which are difficult to be noticed by a human's naked eye. Hence, this project aims to develop an intelligent system to reduce the number of human errors occurred in the hospital. The scanner should be able to identify the tool placed on the platform and tally it with the reference toolset. As such, if there is any missing or wrong tool placed on the platform, the software will be able to warn the user about the error before the tool set is being out processed which in turn reduce the occurrence of missing tools in their inventory as well as incomplete surgical sets in operation theatre With this innovation, it will benefit a large group of people such as the instrument processing department, surgeons and patients. Packaging staffs will be able to work in a less stressful environment and more efficiently without the use of count sheets. With the reduction of human errors, it will reduce the time wastage of the surgeons and the patients. Overall, the efficiency in every aspect will be improved with the success of this innovation.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☒ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical and Computer Engineering, Mechanical and Product Development Engineering
What participants are expected to achieve at the end of 8-week attachment	Proof-of-concept development for the proposed approach
No. of participants able to host	4
Supervisor(s) - Please include link to online bio / research page	Dr Tang Kok Zuea
Name and address of lab that participants will be attached to	Engineering Design and Innovation Centre (EDIC), Innovation and Design, Faculty of Engineering, Block E2A, #04-05, 5 Engineering Drive 2, Singapore 117579

Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	No.

IDP 6

Project title	Using Deep Learning for Medication Recognition
Project description (for website) Note: - no more than 250 words	The report "To err is human" by IOM established that medication errors are the leading cause of morbidity and mortality in healthcare systems. The major contributing factor of medication errors is prescribing faults, followed by administration errors. Medication errors compromise patients' ability to adhere to their medication regimen, resulting in injuries and death. Human errors manifesting from erroneous visual inspection and lack of medication knowledge accounted for most of the reported mortality cases. To address prescribing faults, some commercial systems have surfaced to automate the process of prescribing medication. However, they have insufficient scope and remain prone to implicit human errors. To bridge the gap in medication knowledge, medicines regulatory authority FDA provides detailed information on medication use and standardised drug-related terminologies to the public. The objective is to develop a safer system using deep learning which reduces the likelihood of human errors. This system will recognise and register medication in unit dosage (no packaging) and medication in blister packaging. Experiments will be conducted on actual medication to evaluate the effectiveness of the system.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☒ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical and Computer Engineering, Mechanical and Product Development Engineering
What participants are expected to achieve at the end of 8-week attachment	Proof-of-concept development for the proposed approach
No. of participants able to host	4
Supervisor(s) - Please include link to online bio / research page	Dr Tang Kok Zuea
Name and address of lab that participants will be attached to	Engineering Design and Innovation Centre (EDIC), Innovation and Design, Faculty of Engineering, Block E2A, #04-05, 5 Engineering Drive 2, Singapore 117579
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	No.

IDP 7

Project title	Decoding the Brain
Project description **(for website)** Note: - no more than 250 words	Recent developments in neural recording technologies have made it possible to record from hundreds of individual neurons in the brain. This is a major advance that allows the use of brain signals to control prostheses with large degrees of freedom. It also enables investigators to study the neural code used by populations of neurons to represent and process information in the brain. In this project, we will analyze data recorded from the frontal cortex of awake, behaving monkeys to understand how populations of neurons in different areas respond in a working memory task. We will investigate different neural codes (Bayesian probability, information theory, partial directed coherence, etc.) to understand how information is processed and transformed from one area to another. Students will get to learn to work with large neural data sets, correlate neural data with the behavior of animals, program in Matlab, and perform large-scale data analysis on a High-Performance Computing cluster.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☒ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical and Computer Engineering, Bioengineering/Biomedical Engineering, Computer Science, Neuroscience, Psychology
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Write Matlab/Python code to analyze data and visualize results.
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Dr Shih-Cheng YEN https://tinyurl.com/y26rbm9o
Name and address of lab that participants will be attached to	The N.1 Institute for Health Center for Life Sciences, #05-COR, 28 Medical Drive, Singapore 117456
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Familiarity with Matlab, data acquisition, signal processing, and statistics.

Host Department: Industrial Systems Engineering and Management (https://www.isem.nus.edu.sg/)

ISEM 1

Project title	Gearing Towards A Smart Digital Twin
Project description (for website) Note: - no more than 250 words	It is part of a larger aspiration to build a smart digital twin platform concurrently from 4 dimensions; connectivity, visibility, granularity and analyzability. The participant will be allotted programming task/s based on the algorithms developed by center researchers with considerations to their interests/strengths.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☒ Computing and Analysis ☒ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Computer Science, Management Science, Computing, Industrial Engineering, Systems Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Contribute to holistic realization of smart digital twin via programming of algorithms developed by researchers into useful implementable software codes.
No. of participants able to host	4
Supervisor(s) - Please include link to online bio / research page	Assistant Professor Li Haobin https://sg.linkedin.com/in/haobin-li-ab972731 https://www.isem.nus.edu.sg/research/c4ngl/team/dr-li-haobin/ View accomplishments to get more details of our work.
Name and address of lab that participants will be attached to	Centre of Excellence for Next Generation Ports (C4NGP) Centre for Next Generation Logistics (C4NGL) Innovation 4.0 Building, #04-02, 3 Research Link, S(117602)
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Having programming skills is a pre-requisite. Ability to communicate effectively with varoius stakeholders to understand actual requirements will be preferred.

Host Department: Department of Mechanical Engineering (www.me.nus.edu.sg)

ME 1

Project title	Design and fabrication of acoustic metamaterials for low frequency noise mitigation and anisotropic acoustic wave manipulation
Project description (for website) Note: - no more than 250 words	Acoustic metamaterials are made of periodic or random artificial structures, defined as "meta-atoms" with size that is larger than the conventional atom and much smaller than the target wavelength, are used for control and manipulation of acoustic waves. The goal of this work is to develop the metastructure with subwavelength thickness size for noise mitigation in the low-to-mid frequency range. Several concepts, like coiling-up-space and Helmholtz-resonator, can be explored to design the acoustic meta-absorbers and acoustic barriers. The study also focuses on the emerging field of anisotropic metamaterials for the manipulation of acoustic waves. The project work will be carry out through combined analytical (idea conceiving, necessary theoretical studies), numerical simulations (Abaqus/Comsol), and experimental studies.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies & ☒ Hybrid (e.g., mixture of experiment theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Mechanical Engineering, Design, Finite Element analysis
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	1. Theoretical understanding of acoustic wave propagation. 2. Finite element method based simulations 3. Hands-on experience of 3D printing and sound characteristics measurements
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Assoc. Prof. H. P. Lee https://www.eng.nus.edu.sg/me/staff/lee-heow-pueh/
Name and address of lab that participants will be attached to	Dynamics Lab, # E1-02-03, E1 block, National University of Singapore, Singapore
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	

ME 2

Project title	Characterization of cellular materials fabricated by additive manufacturing for orthopedic applications
Project description (for website) Note: - no more than 250 words	Bone is a rigid organ containing regenerative tissue, which is able to heal itself after physical injury via complex remodeling process. However, the ability of self-healing may become limited for bones subject to serious trauma, pathological fracture or under older age. Orthopedic implants are therefore needed to provide necessary support for such bone in initiating its fracture healing and remodeling process, treating the deformities, balancing body posture as well as maintaining the daily activities of the patient. The proposed project will provide an opportunity to design open cellular materials for orthopedic applications using additive manufacturing in terms of experimental characterizations of morphological details and mechanical properties of the developed materials.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☒ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Mechanical Engineering, advanced manufacturing
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	1) Design and fabricate cellular material samples for orthopedic implants by additive manufacturing; 2) Characterize the cellular materials in terms of morphological details and mechanical properties.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Assoc Prof Lee Heow Pueh http://me.nus.edu.sg/staff.php?id=2102
Name and address of lab that participants will be attached to	Dynamics Lab E1-02-03, 9 Engineering Drive 1, Faculty of Engineering, NUS Singapore 117575
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Ability to implement CAE software such SOLIDWORKS is required.

ME 3

Project title	Machining of Brittle Materials with Surface Effect
Project description (for website) Note: - no more than 250 words	Brittle materials such as glass are commonly categorized as difficult-to-cut materials due to the relatively high hardness and brittleness. Surface modification techniques have been identified to alter metallic surface properties both permanently and temporarily to improve the machinability of these materials. However, the application of surface modification techniques is uncommon and not well understood for optical materials such as calcium fluoride single crystals. In this project, the student will study the effectiveness of various surface-active media through the experimental work and surface analysis on brittle materials. Modification techniques would include the application of chemical solvents or atomistic surface alteration techniques. Surface integrity and sub-surface damage studies of these brittle materials will be conducted with advanced microstructure analysis tools to understand the mechanisms behind the improvement or deterioration of machinability. Completion of the project would provide the student with fundamental knowledge of ultraprecision machining and hands-on experience applicable to the manufacturing of precision optical components based on brittle materials.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Mechanical Engineering / Materials Science
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	• Characterization of the brittle material properties and machinability; • Ductile-regime microcutting of brittle materials; • Evaluation of the machined surface integrity and subsurface damage.
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Asst Prof Wang Hao (https://www.researchgate.net/profile/Hao_Wang255)
Name and address of lab that participants will be attached to	Advanced Manufacturing Laboratory (G/F, Block EA, 9 Engineering Drive 1, Singapore 117575)
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	N/A.

ME 4

Project title	Development of High Performance Metallic Materials for Engineering/Biomedical Applications
Project description **(for website)** Note: - no more than 250 words	This project is an experimental project involving the composition/ processing based modification of the properties of materials. The developed materials will be characterized for their physical, thermal and mechanical properties. Correlation of microstructure and properties will be attempted.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☒ Feasibility/Case Studies
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Basic knowledge of material science is required though not critical.
What participants are expected to achieve at the end of 8-week attachment	Participants will learn the art of processing of materials and characterization using a set of tools such as optical and scanning electron microscopes, hardness and mechanical properties measurements and thermal analysis tools. This will enhance their skill set.
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Manoj Gupta Associate Prof Dept of Mechanical Engineering
Name and address of lab that participants will be attached to	Materials Lab of Dept of Mechanical Engineering
Any other information/ requirements	No requirements but a positive attitude and desire to learn something new.

ME 5

Project title	Multiphase Flow in Pipelines and Multiphase Equipment Development
Project description (for website) Note: - no more than 250 words	In oil & gas production, a multiphase mixture of oil, water and gas flows through a pipeline for long distances. Due to differences in densities, viscosities, and other physical properties, various flow regimes, i.e. stratified, wavy, bubbly, slug, annular and dispersed flows, can develop as a result, depending on the superficial velocities of the fluids. Different flow regimes have different effects on the pressure drop, flow pattern, etc., and ultimately on the stability of the flow. Pipeline integrity can also potentially be compromised due to force loadings from some of the flow regimes. This projects looks into multiphase flow and also into the development of equipment for the oil & gas industry.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☒ Computing and Analysis ☐ Software Development ☐ Design ☒ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Chemical Engineering Mechanical Engineering Process Engineering Offshore Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	Students will have a better appreciation of multiphase flow in pipelines and an understanding of multiphase equipment used in oil and gas transportation.
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Associate Professor LOH Wai Lam http://me.nus.edu.sg/about-us/people/academic-staff/fluid-mechanics/ http://www.eng.nus.edu.sg/core/
Name and address of lab that participants will be attached to	NUS Multiphase Oil-Water-Air Flow Loop Laboratory
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	

Summer Engineering Research Internship for US Students (SERIUS)

Host Department: Department of Materials Science & Engineering (www.mse.nus.edu.sg)

MSE 1

Project title	Solid-state thin film Supercapacitors
Project description (for website) Note: - no more than 250 words	Gel electrolytes have been extensively explored for solid-state supercapacitors. In this work, the objective is to develop a quasi-solid state zwitterionic electrolyte to facilitate superior electrochemical performance of supercapacitors. Simultaneously, using green route hydrothermal process, doped Cobalt oxide will be synthesized to constitute as the thin film electrode. The structure and morphology of the resulting electrodes will be characterized by scanning electron microscopy, transmission electron microscopy, X-ray diffraction, and Raman spectroscopy. The electrocapacitive properties of the supercapacitor will be evaluated by cyclic voltammetry, galvanostatic charge–discharge, and electrochemical impedance spectroscopy techniques. Further, the influence on ionic conductivity of the electrolyte on the capacitance/electrochemical behavior of the supercapacitance can be studied by using additives like KI.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☐ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☐ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Material Science and Engineering, Chemistry, Environmental science
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	• Hands on experience in developing and testing supercapacitors. • 1 publication • Cultural experience and exposure to the fine research facilities available at NUS, Singapore.
No. of participants able to host	1
Supervisor(s) - Please include link to online bio / research page	Prof. Tan Swee Ching http://www.dmse.nus.edu.sg/SweeChingGroup/index.html
Name and address of lab that participants will be attached to	Swee Lab Block E3A - Level 3 (E3A #03-03-02) And Block E3A - Level 5 (E3A #05-16)

	7 Engineering Drive 1, Singapore 117574.
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Basic knowledge of electrochemistry

MSE 2

Project title	AI Driven Design of Self-Repairing Electronic Skins
Project description (for website) Note: - no more than 250 words	The goal of this exciting internship is use AI techniques in combination with novel self-healing materials and sensors that is being developed in the group. The intern is expected to prototype small scale areas of sensors, characterize them mechanical/electronically and work with AI scientists to develop algorithms.
Nature of project (please click on the boxes to check the relevant ones)	☒ Laboratory Investigation ☐ Computing and Analysis ☐ Software Development ☐ Design ☒ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Materials Science and Engineering Mechanical Engineering Applied Physics Electrical/Electronics/Computer Engineering
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	• Hands-on experience with Electrical/mechanical characterization of properties of new self-healing materials • Understanding of how AI/Machine Learning can be applied to material science • High-quality research outcomes in forms of e.g. journal publications
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Dr Benjamin Tee www.benjamintee.com
Name and address of lab that participants will be attached to	Tee Research Group www.benjamintee.com
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Useful softwares to know: Matlab, Labview, Python, OriginLab

MSE 3

Project title	Wearable Digital Health Sensors and Networks
Project description (for website) Note: - no more than 250 words	The goal of this exciting internship is use AI techniques in combination with novel sensors and devices that is being developed in the group. The intern is expected to design and prototype lab-scale sensors, characterize them mechanical/electronically and work with AI scientists/clinicians to develop algorithms that can improve health diagnostics.
Nature of project (please click on the boxes to check the relevant ones)	☐ Laboratory Investigation ☐ Computing and Analysis ☒ Software Development ☒ Design ☒ Product Development ☐ Field Testing and Instrumentation ☐ Feasibility/Case Studies ☒ Hybrid (eg mixture of experiment & theoretical, or experimental and numerical/software) ☐ Others: _____
Relevant majors - you may indicate more than one, especially if project is cross-disciplinary	Electrical/Electronics/Computer Engineering Mechanical Engineering Applied Physics Pre-med
What participants are expected to achieve at the end of the 8-week attachment - no more than 3 top outcomes	• Hands-on experience with Electrical/mechanical characterization of properties of new sensor materials • Understanding of how AI/Machine Learning can be applied to material science and health wearables • High-quality research outcomes in forms of e.g. journal publications
No. of participants able to host	2
Supervisor(s) - Please include link to online bio / research page	Dr Benjamin Tee www.benjamintee.com
Name and address of lab that participants will be attached to	Tee Research Group www.benjamintee.com
Any other information/ requirements (eg programming skills, prerequisites, reading list, etc)	Useful softwares to know: Matlab, Labview, Python, OriginLab, C/C++, Arduino, Firmware