Bright Future Engineering Talent Hub
STEM Challenge 2025 – Suggested Project Themes

Department	Code	Project Theme	Description
Architecture and Civil Engineering 建築學及土木工程學	ACE-C1	How to Build a Moon Station? 如何建造月球基地	Students are required to design a structure based on all the available resource in moon to build a moon station. Best scientific explanation determines the winner. 學生需要設計一個月球基地, 並要使用月球上所有可用的資源來建造。擁有最佳科學解釋者勝。
	ACE-C2	Smart Energy Management for Homes 智慧家居能源管理	Smart energy management is one efficient way to reduce the energy use of residential buildings as well as the monthly bills. Students are encouraged to develop practical strategies and tools that could be installed at home to monitor and manage electricity use of different devices (such as air-conditioners, lighting, fans, etc.), so as to reduce electricity waste. Simple calculations or experiments could be used to demonstrate the design performance. 智慧能源管理是減少住宅建築能源使用以及每月帳單的一種有效方法。鼓勵學生開發實用的策略和工具來監測和管理住宅建築中不同設備（如空調、照明、風扇等）的用電情況，減少電力浪費，並使用簡單的計算或實驗來驗證所開發的策略和工具的性能。
	ACE-C3	How to Cool our	Students will explore innovative ways to cool buildings using natural

		Building using Natural Ventilation? 如何通過自然通風降低室內溫度	ventilation techniques. 學生將會探索如何利用自然通風來降低室內溫度。
Biomedical Engineering 生物醫學工程學	BME-C1	Explore Microorganisms and Anti-microbial Approaches 探索微生物及抗微生物方法	In this challenge, students will form teams of 3-4 people and perform tasks as a group. They will be challenged with the following questions: 1. Search literature and the internet, collect information on different types of microbes, such as ones that prefers cold/hot temperature, ones that are pathogens of some common diseases, etc., and what is the usually way to kill them. They can demonstrate the morphology of bacteria and their properties with handcraft art or presentation. 2. They will study the growth curve of E. coli (nonpathogenic) in different medium. Try different antiinfections in everyday life (like soap, salt solution, bleach, antibiotics) and explore their effect on bacteria growth. Present their results to the audience. 在這個挑戰中，學生將組成 3-4 人的團隊並以小組形式進行任務。他們將面臨以下問題的挑戰： 1. 搜尋文獻和互聯網，收集有關不同類型微生物的信息，例如喜冷/熱環境的微生物、某些常見疾病的病原體等，以及相應的抗菌方法。他們可以用手工藝品或報告展示細菌的形態及其特性。 2. 他們將研究大腸桿菌（非致病性）在不同培養基中的生長曲線。嘗試日常生活中的不同抗菌方法（如在培養基中添加肥皂、鹽水、漂白

			劑、抗生素等），並探索它們對細菌生長的影響。將他們的結果呈現給觀眾。
	BME-C2	How to Protect against UV Exposure? 探索有效防護紫外線的方法	Understanding the science behind UV-induced damage and UV protection is important for overall health. This project provides a great opportunity for students to learn about chemistry, biology, and experimental design. The students will first learn the principles of various UV protection methods. They will then conduct tests to compare the effectiveness of these measures. For instance, they will evaluate different sunscreens and measure their efficacy in protecting against UV radiation. 理解紫外線引起的生物損傷及紫外線防護的科學原理對於我們的健康非常重要。這個項目將為學生提供學習化學、生物，和實驗設計的機會。學生們將首先了解各種紫外線防護方法的原理。其次，他們將對這些防護方式進行測試，比較這些方法的有效性。例如，他們可以評估不同防曬霜的效果，測量它們防護紫外線輻射的功效。
	BME-C3	Building a Small Portable Microscope 搭建一台小型顯微鏡	Optical microscopy allows us to visualise features beyond the capability of our natural eyes. In this project, students will design and build a small, portable microscope. Using this microscope, students will demonstrate its performance by imaging structures of their interest. This project provides a fantastic opportunity for students to explore optics, engineering, and biology, involving hands-on building and understanding the principles of microscopy. 光學顯微鏡使我們能夠看到超出自然視覺分辨力的微小結構。在這個項目中，學生將設計，並搭建一台小型、便攜式顯微鏡。在顯微鏡搭建成功後，學生們可以對他們感興趣的結構進行成像，來展示其性能。

			這個項目將為學生提供一個探索光學、工程學、和生物學的機會，讓他們可以通過實踐，更深入地理解顯微鏡原理及應用。
	BME-C4	Actuation of a Capsule Robot within Human Body 對體內膠囊機器人的驅動控制	Students need to use an external permanent magnet to drive a capsule robot that is constrained to a tubular environment filled with viscous liquid. The winner will actuate the robot to complete a trip from point A to point A using the least amount of time. 學生需要使用外部永久磁鐵來驅動膠囊機器人，該機器人被限制在充滿黏性液體的管狀環境中。獲勝者將驅動機器人使用最少的時間完成從 A 點到 A 點的行程。
	BME-C5	Guidance of a Medical Catheter into the Cardiovascular Network 引導醫用導管進入心血管網絡	Students need to use an external permanent magnet to guide a medical catheter to navigate within the narrow and tortuous cardiovascular network to several designated locations. The winner will finish reaching all designated locations using the least amount of time. 學生需要使用外部永久磁鐵引導醫用導管在狹窄而曲折的心血管網路內導航到幾個指定位置。獲勝者將以最短的時間到達所有指定地點。
Computer Science 電腦科學	CS-C1	Exploring Multi-LLM Collaboration 探索多重 LLM 協作	Students will explore collaborative AI systems by integrating multiple large language models (LLMs) to perform diverse tasks, such as answering questions, generating creative writing, and solving math problems. They will design and test workflows to route tasks to the most suitable model, optimising performance, cost, and accuracy. By the end, students will create and evaluate their own multi-LLM system through simulated user

			queries. 學生將通過整合多個大型語言模型（LLMs）來探索協作式人工智能系統，執行各種任務，如回答問題、生成創意寫作和解決數學問題。他們將設計和測試工作流程，將任務路由到最合適的模型，優化性能、成本和準確性。最終，學生將通過模擬用戶查詢創建和評估自己的多重 LLM 系統。
	CS-C2	Automatic Knowledge Graph Construction using Large Language Model 使用大型語言模型進行自動知識圖構建	This project aims to explore the automatic construction of knowledge graphs from literature and reports. Specifically, we will utilise public pre-trained language models such as BERT or GPT to extract entities and relationships from unstructured text data. We will then use these extracted entities and relationships to construct a knowledge graph, which can be used for various downstream applications such as question answering or text summarisation. The project will be implemented using popular NLP libraries such as Hugging Face. By leveraging the power of large language models, we hope to create a scalable and efficient approach to automatic knowledge graph construction. 該項目旨在探索從文獻和報告中自動構建知識圖。具體而言，我們將利用公開預先訓練的語言模型，如 BERT 或 GPT，從非結構化文本數據中提取實體和關係。然後，我們將使用這些提取的實體和關係來構建知識圖，可用於各種下游應用，如問答或文本摘要。該項目將使用流行的 NLP 庫，例如 Hugging Face 進行實現。通過利用大型語言模型的能力，我們希望創建一種可擴展且高效的自動知識圖構建方法。

Electrical Engineering 電機工程學	EE-C1	Enhancing Student Learning and Self-Reflection Through Generative AI Tools 透過生成式人工智慧工具增強學生的學習和自我反思	This project investigates how Generative AI tools can boost student learning and self-reflection in STEM education. By incorporating AI models like GPT-o1, Claude, or LLaMA3.2 into the educational process, students can obtain personalised feedback, pinpoint areas where their knowledge is lacking, and gain a deeper grasp of intricate concepts. Our aim is to create and implement an AI-driven framework (study methodology) that promotes student self-reflection, encourages active learning, and nurtures a growth mindset. We will examine the effects of this technology on student outcomes, engagement, and motivation, with the ultimate goal of establishing a more effective and student-focused learning environment. 本計畫研究生成式人工智慧工具如何促進學生在 STEM 教育中的學習和自我反思。透過將 GPT-o1、Claude 或 LLaMA3.2 等人工智慧模型融入教育過程中，學生可以獲得個人化回饋，找出其知識缺乏的領域，並更深入地掌握複雜的概念。我們的目標是創建並實施一個人工智慧驅動的框架（學習方法），促進學生自我反思、鼓勵主動學習並培養成長心態。我們將研究這項技術對學生成績、參與度和動機的影響，最終目標是建立一個更有效、以學生為中心的學習環境。
Mechanical Engineering 機械工程學	MNE-C1	Future Concentrated Solar Plants: Smart Sun Collector, Harnessing Solar Power 未來光熱能：智能陽光收集器，捕捉太陽的能量	Light can do more than just generate electricity directly; it can also be collected to heat fluids and produce power. This is the principle behind concentrated solar power (CSP), a green energy technology that utilises the sun's heat to drive turbines and generate electricity. CSP plays a vital role in the future of renewable energy. Imagine yourself as an energy engineer, designing the core of tomorrow's solar power stations! In this project, you will build a miniature central tower CSP station, combining smart technology and engineering creativity to tackle real-world renewable

			energy challenges. Your goal is to track the "sun" as it moves across the sky, reflecting its rays precisely onto a central tower to maximise light intensity. Using motorised mirrors with two degrees of freedom, you will dynamically adjust their angles. An Arduino-powered control system will connect light sensors and motors, enabling automated tracking and optimisation based on the sun's position, simulating cutting-edge solar tracking technology. You will also assemble a light source that mimics the sun's daily movement, build a sensor-equipped central tower, and refine your design through data analysis and problem-solving. Finally, showcase your fully functional smart solar collector, demonstrating the power of science and engineering. 光除了可以直接轉化為電能，還可以通過收集並加熱流體來發電，這便是光熱電站（CSP）的原理。作為一種利用太陽的綠色能源技術，光熱電站在未來能源中扮演著至關重要的角色。想像自己是一名能源科技的設計師，負責未來太陽能電站的核心設計！在這個專案中，你將親手設計並建造一個迷你的「聚光式 CSP」模型，運用智慧科技和工程創意，模擬真實世界中的可再生能源挑戰。 你的目標是追蹤「太陽」的移動軌跡，將光線精確地反射到中央塔上，以實現光強度的最大化。透過電機控制的反光鏡（鏡面可進行雙自由度旋轉），你可以動態調整反射角度，並利用 Arduino 程式控制系統，讓光感應器與電機協同工作，自動根據「太陽」的位置變化優化反射效果，模擬最尖端的太陽能追蹤技術。 此外，你將組裝一個可模擬太陽升起與落下軌跡的光源系統，建造配備感應器的中央塔，並運用數據分析和問題解決能力來不斷改進設計。最後，透過展示和演示，你將向大家呈現一個完整運作的智能太陽能

			收集器，展現科學與工程的魅力。 這不僅是一個動手實驗的旅程，更是了解可再生能源未來發展的探索。準備好成為下一位能源創新者了嗎？
Materials Science and Engineering 材料科學及工程學	MSE-C1	Develop a New Waterproof Surface Treatment Methods for Shoes 開發鞋類新防水表面處理方法	Students will research and develop new, cheap, and durable treatment methods to make shoes waterproof. 學生將研究和開發新的、廉價的、耐用的處理方法來使鞋子防水。
	MSE-C2	Efficient Green Hydrogen Production using Everyday Materials 利用日常材料高效生產綠色氫能	This STEM Challenge project invites students to address the global challenge of clean energy production. Your task is to design and demonstrate an innovative method to produce green hydrogen efficiently using daily materials. Hydrogen, as a clean energy source, is vital for reducing carbon emissions and combating climate change. Participants will explore electrolysis, material science, and energy conversion. Students will test hypotheses, optimise designs, and create solutions that maximise hydrogen production while minimising energy use and environmental impact, contributing to a sustainable future. 這次 STEM 挑戰賽邀請學生一同應對清潔能源生產的全球性挑戰。參賽者的任務是設計並展示創新方法，利用日常材料高效地生產綠色氫能。作為一種清潔且可持續的能源，氫氣對減少碳排放及應對氣候變化至關重要。 在挑戰過程中，參賽者將深入探索電解、材料科學及能量轉換的原理，驗證假設並不斷優化設計，以提升氫氣產量，同時降

			低能耗及環境影響。這項挑戰不僅啟發創新思維，還將引導學生為建設可持續的未來提出實用解決方案。
Systems Engineering 系統工程學	SYE-C1	Smart Transport and Logistics 智慧交通與物流	The emerging Internet of Things (IoT) technologies has enabled collection of transportation data, exchange of information, and implementation of traffic control actions via the internet or various vehicle-to-infrastructure (V2I)/ vehicle-to-vehicle (V2V) communication networks. Students will design and develop various prototypes for intelligent traffic control framework that can fully incorporate the capability of the emerging IoT-based sensing, computing, and control technologies. Examples include intelligent traffic lights, autonomous vehicles, smart parking, inventory control and logistic systems. 新興的物聯網 (IoT) 技術使我們可以通過互聯網或各種車輛對設施 (V2I) /車輛對車輛 (V2V) 通信網絡收集交通數據、交換信息和實施交通管制。學生將設計和開發新穎的智能交通和物流控制模型，充分結合這些新興物聯網的傳感功能、運算和控制技術。例子包括智能交通燈、自動駕駛汽車、智能泊車、庫存控制和物流系統。
	SYE-C2	Smart Poultry Farming 智能家禽養殖	The occurrence of avian influenza has a significant impact on the poultry farming income of poultry farmers. It is estimated that an outbreak of avian influenza will cause an average decrease of 65% in poultry farming income of poultry farmers. With the design of smart poultry farming, we expect to control the spread of the virus within the farm, therefore, reducing the death of the poultry and saving the damage caused by the outbreak of the virus.

			禽流感的發生對養雞戶的養禽收入影響很大。據估計，禽流感的爆發將導致養禽養殖戶的養禽收入平均減少 65%。通過智能家禽養殖的設計，我們能夠控制病毒在農場內的傳播，從而減少家禽的死亡，挽救病毒爆發造成的損失。
	SYE-C3	Fault Diagnosis in Smart Manufacturing 智慧製造中的故障診斷	Fault Diagnosis is critical to ensure safety in operations during smart manufacturing processes. Leveraging the advanced sensing techniques with multiple transduction mechanisms, large amount of monitoring data can be obtained for machinery. By using these sensor data, students will first understand the physics of the sensor signals and then apply various machine learning algorithms to identify the fault status in using the machines as well as predict the remaining service life of the machinery. 在智能製造過程中，故障診斷在確保操作安全中起到關鍵作用。利用先進的多模式傳感器技術，機械的大量監測數據可以採集到。利用這些數據，學生們將首先理解這些傳感器信號的物理意義。之後將應用不同的機器學習算法去診斷機械故障同時預測機械的剩餘使用壽命。
	SYE-C4	Classifier for License Plate Detection 自動車牌檢測分類器設計	Students will collaborate to learn the Python programming language and machine learning models, specifically focusing on image classification. They will apply their logical thinking and creativity to design and implement a classifier. The primary task will be to identify digits in noisy images for real-world applications such as automatic license plate detection.

			學生們將合作學習 Python 編程語言和用於圖像分類的機器學習模型。他們將運用邏輯思維和創造力來設計和編寫分類器，以從雜訊圖像中識別數字，用於自動車牌檢測等實際應用。
	SYE-C5	Building a 3D Prototype and Hologram of Smart City 構建智慧城市 3D 模型和全息影像	A smart city employs various electrical devices and sensors to gather and use data efficiently. Students will design and build a 3D smart city prototype in computer software and demonstrate the prototype using a home-made 3D pyramid hologram system. Example includes design a new transportation system that links multiple city facilities using self-driving vehicles, etc. 智慧城市採用各種電氣設備和傳感器來有效地收集和使用數據。學生將使用計算機軟件設計和構建 3D 智慧城市模型，並使用自製的 3D 金字塔全息系統演示該模型。示例包括設計一個使用自動駕駛車輛連接多個城市設施的新交通系統等。
	SYE-C6	DSG Forecast Model 分散式光伏預測	How to effectively predict the distribution of photovoltaic power generation is a key factor in helping integrate distributed photovoltaic solar energy into the grid. There are already over 200 historical data points for distributed photovoltaic power generation, with more than 140 locations used as the training set and over 60 locations used as the validation set. By constructing a data learning model, the best prediction results can be achieved. 如何有效的預測分散式光伏發電是幫助分散式光伏太陽能並網的關鍵因素，已有 200 多個分散式光伏發電的歷史資料，其中 140 多個地點

			作為訓練集，60 多個地點作為驗證集，搭建資料學習模型，取得最好的預測結果。
	SYE-C7	Machine Learning - Augmented Discrete Optimisation 機器學習 - 增強離散優化	Students will explore how to leverage machine learning methods to enhance discrete optimisation techniques. They will learn to use Python toolkits to implement learning-augmented methods and apply them to boost the performance of discrete optimisation algorithms. 學生將探索如何利用機器學習方法來增強離散優化技術。他們將學習使用 Python 工具包來實現學習增強方法，並應用它們來提高離散優化演算法的效能。
	SYE-C8	Bayesian Optimisation for Complex Industrial Process Intensification 基於貝葉斯優化的複雜工業過程強化	Students will explore how to use a derivative-free optimisation algorithm, Bayesian Optimisation, to solve large-scale, nonconvex optimisation problems arising from complex industrial processes involving differential equations and bi-level optimisation structures. 學生將探索如何使用無導數優化算法——貝葉斯優化，來解決由涉及微分方程和雙層優化結構的複雜工業過程中產生的大規模非凸優化問題。
	SYE-C9	Deep Learning Based Image Segmentation for Cell Nucleus	Cell nuclei play a critical role in understanding the structure and function of cells, making their detection and segmentation vital for many medical and biological research applications. Image segmentation using deep learning has emerged as a powerful tool for accurately identifying and

		Detection 基於深度學習的細胞核圖像分割	isolating cell nuclei in microscopic images. In this project, students will explore the basics of deep learning by building and training a neural network for image segmentation. They will focus on understanding how convolutional neural networks (CNNs) can be applied to detect and segment cell nuclei in microscopic images. Using a curated dataset, students will collaborate to design and implement a simplified version of the U-Net architecture, evaluate its performance, and refine their model. 細胞核在理解細胞結構和功能中具有重要作用，其檢測和分割對於許多醫學和生物研究應用至關重要。基於深度學習的圖像分割技術已成為準確識別和分離顯微圖像中細胞核的有力工具。在本項目中，學生將學習深度學習的基礎知識，並設計及訓練一個神經網絡進行圖像分割。他們將了解如何應用卷積神經網絡（CNN）來檢測和分割顯微圖像中的細胞核。在使用經過挑選的數據集的過程中，學生將合作設計和實現一個簡化版本的 U-Net 架構，評估其性能並進行改進。
	SYE-C10	Building Flexible Photovoltaic Windows 構建柔性太陽能窗戶	Students will explore how to fabricate flexible, large-area photovoltaic windows. They will study the principles and characterisation methods of perovskite solar cells, and use the doctor blade coating technique to construct large-area devices. As part of the project, they will develop a prototype that powers small household appliances. 學生將探索如何製備柔性大面積太陽能智慧窗戶的製造技術。他們將學習鈣鈦礦太陽能電池的原理及表徵方法，並使用刮塗技術構建大面積器件驅動小型家用電器的實施範例。