Cambridge Engineering Thinking + PBL 2024 Course Syllabus

PBL Track: Engineering Insight: Developing a Robust Data Analytics System for Smart Industrial Equipment Predictive Maintenance

I. Course Information

Course Dates	22nd January - 4th February 2023
Course Duration	2 Weeks
Course Hours	40 hours in total It includes a total of 24 hours of Lectures and Supervisions delivered by Cambridge professors and experts in both Foundation Module and PBL modules, 16 hours of Group workshops and practical sessions.
Pre-requisites	A background in basic statistics is required for the course. Programming experience is helpful but not necessary.
Assessment	Assessed individually and in groups through group projects
Skills Trained	Problem solving, design thinking, project planning, teamwork, presentation, communication
Materials Required	Internet connection and devices for writing, interacting with online templates such as Google Docs, researching a project and preparing for a final group presentation

II. Course Description

‘Systems that work do not just happen – they have to be planned, designed and built.’ So said the Royal Academy of Engineering in 2007. To maximise success in an increasingly complex world, employing design thinking and systems thinking is even more important now than it was then. We often hear calls for ‘systems thinking’ and a ‘systems approach’, but how can this be done? This course will teach students to follow a method for systems thinking that has been employed successfully in many domains, including in the world of healthcare systems design and at government and policy level.

Embark on an enthralling exploration of system design, presented through a nuanced, application-driven lens. Delve into the foundational tenets that govern this vast domain, setting the stage for deeper engagement. As we transition from elemental constructs to sophisticated methodologies, participants will be invited to immerse themselves in carefully curated Project-Based Learning (PBL) scenarios. These hands-on experiences aim to cultivate and crystallize the design ideologies inherent to the field.

To culminate this transformative learning experience, students will channel their newfound knowledge and insights into a capstone project— an opportunity to showcase, reflect, and innovate on the principles imbibed throughout this enlightening journey.

III. Goals & Objectives

The course will introduce the concept of design thinking and a systems approach through four perspectives: systems, design, risk and people. It is anticipated that many principles learned will be useful for the rest of the students' lives as it will help students to learn a method for design that can be used to help create future systems in a wide range of domains.

Fourfold Insight: Dive deep into the realms of:

🌐 **Systems**: Understanding the intricate web of interconnectivity.

✍️ **Design**: Crafting solutions with elegance and functionality.

⚠️ **Risk**: Foreseeing and mitigating potential pitfalls.

👫 **People**: Centering the human element in all endeavors.

Timeless Takeaways:

🎓 Equip yourself with principles that transcend time, and remain pertinent throughout your life's journey.

Universal Application:

🚀 Master a design methodology, not just for the present, but to mold and shape the systems of the future across diverse domains.

IV. PBL in Engineering Insight: Developing a Robust Data Analytics System for Smart Industrial Equipment Predictive Maintenance

Objective:

Design and implement a data-driven system capable of predicting maintenance needs for industrial equipment, optimizing operational efficiency, and reducing unplanned downtimes.

Description:

The fusion of engineering and data analytics can revolutionize the realm of equipment maintenance. In this PBL module, participants will harness the power of data analytics to predict the maintenance requirements of industrial machinery. They'll employ sensor data, historical maintenance records, and advanced analytics algorithms to develop a solution that not only predicts but helps extend the lifespan of equipment, saving costs and ensuring smoother operations.

Key Components & Milestones:

1. Understanding the Industrial Context
2. Data Collection & Sensor Integration
3. Feature Engineering & Model Selection
4. System Development & Integration
5. Validation & Testing
6. Stakeholder Feedback & System Enhancement
7. Deployment Strategy & Scalability

Outcome:

Upon completion of this PBL module, participants will possess a deep understanding of how data analytics intersects with engineering challenges in the industrial realm. With a working predictive maintenance system in hand, they'll be prepared to drive innovation in industries, enhancing operational efficiency through informed, data-driven decisions.

V. More information

Assessment

Learning will be assessed through small group presentations at the end of the course. Each individual will be expected to present within their group presentation time. The quality of the presentation will be assessed by the instructor. Teams will need to demonstrate how they have used a systems approach to plan or design an improvement. The emphasis will be on the process they have followed rather than the quality of the finished product.

Format

The course will take place in a face-to-face format, interspersed by self-directed group work, to prepare for the assessed presentation.

Reading List

Readings will be provided to students prior to the course.