## 1. Scope of the Course

Introduce participants to fundamental composite material analysis theories, commonly used composite material types, and manufacturing processes to enhance their ability to apply fiber-reinforced composites in future AEAS projects.

## 2. Course Description

This course will include:

- Composite material homogenization theory equivalently transforms anisotropic materials into homogeneous materials at the microscopic scale.
- Classical laminate theory analyzes the stress and deformation behavior of laminated composites at the macroscopic scale.
- The strength estimation of pipes and pressure vessels calculates strength under internal pressure, axial, and bending stresses.
- Manufacturing processes cover the processing and forming steps of composite materials and products.

## 3. Target Audience

This course will benefit students engaged in mechanical structure and mechanism design within the research team and newly joined engineers.

It is suitable for students who have previously studied tensor operations in engineering mathematics, statics, and mechanics of materials and wish to gain a deeper understanding of structural design related to the aerospace industry.

## 4. What You Will Learn

- Classification and Introduction of Composite Materials
- Ability to calculate equivalent material properties and predict the macroscopic mechanical behavior of unfamiliar composite materials.
- Ability to analyze laminated composites' stress, strain, and deformation to optimize stacking design.
- Fundamental principles of composite lamination and angle design.
- Ability to calculate the strength and safety factors of pressure vessels and pipes for structural design.
- Ability to plan material selection, forming techniques, and manufacturing processes to enhance production efficiency and quality.

## 5. Course Outline

- Introduction to Composite Material Applications
- Composite Material Homogenization Theory
- Classical Laminate Theory
- Composite Material Strength Estimation
- Composite Material Manufacturing Processes

## 6. Instructor

Tzu-Cheng, currently pursuing a master's degree in mechanical engineering at Eindhoven University of Technology in the Netherlands, specializes in composite material research. He graduated from the Department of Aeronautics and Astronautics Engineering and, during his studies at National Cheng Kung University (NCKU), participated in the overall structural development of the IRIS-A satellite in the SpaceLab of the Department of Electrical Engineering. This was the first CubeSat project led by NCKU.

He was also involved in the university's UAV team, where he gained experience in manufacturing foam material UAVs and fiber-reinforced skins. Later, he founded NCKU's first student team dedicated to rocket development, the Institute of Space Propulsion (ISP), which developed a series of Yan-Cheng rockets as standardized test platforms for avionics, parachutes, and other subsystems. During the early stages of the club's establishment, he played a key role in laying the foundation for future research.

## 1. 課程宗旨

介紹學員基礎的複合材料分析理論、常用的複合材料種類以及製造流程等，以強化未來在逆熵各項計畫中對於纖維強化複合材料的應用能量。

## 2. 課程概述

本課程將包括：

- 複合材料均質化理論，將異向性材料在微觀尺度上等效為均質材料。
- 古典層板理論，巨觀尺度上分析層壓板應力與變形行為。
- 管件和壓力容器強度估算，計算內壓、軸向與彎曲應力下的強度。
- 製造流程，複合材料加工與產品成型步驟。

## 3. 目標受眾

本課程將有益於研究團隊中從事機械結構與機構設計的學生以及新加入團隊的工程師。

- 之前修過工程數學中的張量運算、靜力學和材料力學課程，並希望更深入了解與航太工業相關結構設計的學生。

## 4. 你會學到

- 複合材料的分類與介紹
- 能夠計算等效材料性質，預測陌生複合材料的宏觀力學行為
- 能夠分析層壓板的應力、應變與變形，最佳化層疊設計
- 複合材料疊層基本原則與角度設計
- 能夠計算壓力容器與管件的強度、安全係數，進行結構設計
- 能夠規劃材料選擇、成型技術與加工流程，提高生產效率與品質

## 5. 課程大綱

- 複合材料應用簡介
- 複合材料均質化理論
- 古典層板理論
- 複合材料強度估算
- 複合材料製造流程

## 6. 講師

目前在荷蘭恩荷芬理工大學就讀機械系碩士的子承，專長是複合材料研究。畢業於航太系，在成大就讀期間曾參與電機系SpaceLab的IRIS-A衛星總體結構開發，是第一顆由成大主導的立方衛星計畫。曾參與航太系無人機系隊，有製作過發泡材料無人機、壓製纖維強化機身蒙皮的經驗。隨後成立成大第一個以製作火箭為目標的社團「太空推進研究社」，領導團隊開發出「雁承號」系列小火箭作為航電、降落傘、推進等次系統的標準測試載台，在社團成立初期建立研究基礎。