理 學 院
108 學年度第一學期模組化課程

物理系統平衡方程式裏的數學結構與解法
Mathematical structure in physical equilibrium equations and their solutions

授課教師：

許瑞麟

課程類別	學分數	選必修	開課人數	注意事項
講義+演習	**1**	**選修**	**30**	

先修課程或先備能力：

無

建議修課年級：

大二、大三、大四、碩士班

建議修課學生背景：

適合各領域學生修習

教學方法：

講授 70%，報告/討論 30%

評量方式：

問題考試 40%；
期末報告 40%；
其他 20 %：發問問題
補充說明：星期二、三、四、五每天 9:00-9:50 先小考，考試內容為前一天上課內容。考試目的是為了提示課程重點，並確保學習成效。考試方式為開放式引導式考試。學生可於考試時舉手發問，老師或助教會趨前給予適當提示並引導作答。不舉手發問視為自動放棄權利。每次小考佔 10%，四次共 40%。期末報告主要是撰寫課程 1000 字心得報告，內容必須包含「課程總結」、「數學結構與解法自我整合筆記」、以及「學習心得」三部分，於課程結束後隔周一繳交，繳交方式另行通知。

學習規範：

無

課程概述：

In this modular course, we introduce three types of problems in applied mathematics and physics. Each one is fundamental in its own field - mechanics, electrical networks, and fluids. What makes it possible to study three different applications all together is that, mathematically, they fit into a single framework which describes an equilibrium state of a system.

We first study how to model the equilibrium of states into a system of linear equations (in discrete systems, such as a line of springs or an electrical network); or into a (partial) differential equations (in continuous systems, such as an elastic bar or a 2D-fluid flow). In solution methods, we focus on solving the Laplace equation (a continuous equilibrium equation) with a circle boundary condition via Fourier series.

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課程進度：

堂次	時數	進 度 說 明
8/5	14:00-17:35	Equilibrium states for a line of springs. Diagram for the rank theorem in linear algebra. The Stiffness matrix.
8/6	14:00-17:35	Equilibrium states for a continuous bar. The minimum potential energy.
8/7	14:00-17:35	From mechanic to electrical network. Continuous flow on the plane.
8/8	14:00-17:35	Solution to Laplace equation. Fourier series.
8/9	14:00-17:40	Fourier Series (Cont'd).

課程學習目標：

1. Learning how to model a physical equilibrium states into a system of linear equations or a Laplace equation.

2. Learning related linear algebra knowledge, including a matrix and its transpose; rank theorem; concept of null spaces; dual linear functional spaces.

3. Learning fundamental knowledge on Fourier analysis, including complex analysis, complete orthogonal systems, convergence issues.

4. Being able to piece together mathematical contents behind different applications. The unifying view will enable the students to face new applications in the future.

課程的重要性、跨域性與時代性：

This course bridges between calculus and linear algebra; between mathematics and physics; and between mathematics and applied mathematics. It focuses on equilibrium equations for physical phenomena, from mechanics to electrical networks; and from discrete to continuous. Solution methods for solving the Laplace equation on the unit disc delivers a concise and complete introduction to the theory of Fourier series.

其他備註:

參考書目：

Introduction to Applied Mathematics, by Gilbert Strange (MIT)