國立台灣科技大學 114學年 第2學期　課程大綱

Spring 2026 NTUST Course Outline

授課教師：陳沛清

Instructor:Pei-Ching Chen

課程名稱：結構控制

Course Title：Structural Control

2026/11/3

課程代號： CT6007701 Course Code 學分數： 3 Credits	必選修：選修/半學年 Required/Electve:Elective/Half Yr. 先修課程： Prerequisites
節次教室： Time/Location	F2(IB-601-2) F3(IB-601-2) F4(IB-601-2)
專業核心能力： Core Professional Competencies	
課程網址： Course Website	
課程宗旨： Course Objectives	The Structural Control course focuses on regulating the dynamic behavior of structures to improve safety, comfort, and serviceability, particularly in response to seismic, wind, or traffic-induced forces. Unlike passive methods that rely on inherent structural properties, the course emphasizes active and semi-active control methods, which provide adaptive solutions for mitigating dynamic loads. Active control uses external energy sources and devices to counteract vibrations, while semi-active control adjusts system properties without requiring significant power. Students who complete the course will gain a deep understanding of control theories such as feedback, optimal, and model-based control, and learn numerical simulation techniques for modeling and testing various control strategies. The course aims to equip students with the ability to analyze and design controllers for structural systems, evaluating their effectiveness in reducing seismic responses through software simulations and real-world case studies. A key component of the course is a practical laboratory project where students will design and implement a controller to suppress seismic response in a reduced-scale structure. By the end of the course, students will have developed the skills necessary to design, analyze, and implement structural control systems, preparing them for applications in seismic mitigation and other dynamic load scenarios.
課程大綱： Outline of Lectures	

- Overview of Structural Control and Review of Structural Dynamics
- Fundamentals of Classical Control
  - -Laplace Transform
  - -Transfer Function
  - -Bode Plot
  - -Block Diagram
- PID Control
  - -PID Tuning
  - -Tracking Performance
  - -Disturbance Rejection
- State Space System
  - -State Space Representation
  - -Solution of State Equation
  - -State Space to Transfer Function
- Smart Base Isolation System
  - -MR Damper
  - -Bouc-Wen Model
  - -Clipped Control
- State Feedback Control
  - -Controllability & Observability
  - -Pole Placement
- State Estimator
  - -Augmented System
  - -Estimator Design
- Linear Quadratic Gaussian (LQG)
  - -Cost Function
  - -Algebraic Riccati Equation
  - -Kalman Filter
- Discrete Time System
  - -State Equation
  - -Z Transform
- System Identification
  - -H1 and H2 Method
  - -System Identification Toolbox
- Modal Control
  - -Similarity Transformation
  - -Modal LQR Control
  - -Modal PID Control
- Nonlinear Control
  - -Fuzzy-Logic Control
  - -Sliding-Mode Control

授課方式： Method of Instruction	講授 Lecture：80% 分組討論 Group discussion：0% 案例研討 Case study：20% 操做練習 Practical exercises：0% 講授 Lecture：%
教科書： Textbooks	Handout and slides from the lecturer
參考書目： References	1. Gene F. Frankline et al., "Feedback Control of Dynamic Systems", Pearson, 7 edition. 2. Chi-Tsong Chen "Linear System Thoery and Design",The Oxford Series in Electrical and Computer Engineering, 4th Edition. 3. Bill Messner et al., "Control Tutorials for MATLAB and Simulink", web-based: http://ctms.engin.umich.edu/CTMS/index.php?aux=Home 4. S.Y. Chu et al., “Active, Hybrid, Semi-Active Structural Control - A Design and Implementation Handbook”, John Wiley and Sons.
修課須知： Notice	

	1. A tutorial of MATLAB/Simulink will be given in the class; however, students may have to get familiar with MATLAB/Simulink through practice by themselves. 2. For those students who have questions related to lecture and homework assignments, please visit the lecturer during the office hour. Office hour: TBD 3. Experimental validation of active control application in the structural laboratory is considered unique worldwide which becomes the highlight of this course.
評量方式： Grading	Attendance and Performance 10% Homework Assignments 30% Term Project 30% Final Project 30%
備註說明： Notes	Prerequisite: Structural Dynamics