

國立中正大學機械工程學系 111 學年度第二學期教學大綱表

課程名稱：(中文)數位控制 (英文)Digital Control					開課單位	機械系
					課程代碼	4205776
授課教師	洪博雄	學分數	3	選修	開課年級	碩士班/ 大三、大四 可修
先修科目或先備能力：自動控制（大學部課程）、線性系統（研究所課程）						
課程概述：The class is divided into the following three parts.<u>Note that the discrete-time systems considered are all linear time-invariant (LTI) ones.</u> ■ Part 0. Overview ■ The overview is prepared not only to give an overall picture of digital control design but also to highlight the continuation from the analog control design, learned from undergraduate automatic control class, to this digital control design ■ Part I. Modeling of LTI discrete-time systems ■ Recall that differentiation equations and Laplace transform were employed to model continuous-time dynamic systems in time domain and in frequency domain, respectively. ■ Similarly, for modeling discrete-time systems we have tools like difference equations and z-transform. ■ In Part I, we will introduce difference equations as a tool to model discrete-time systems in time domain first and then practice z-transform to model discrete-time systems in frequency domain. ■ Part II. Analysis of LTI discrete-time systems ■ Poles and stability ■ Transient analysis in time domain including time constant, overshoot, settling time ■ Controllability and stabilizability; observability and detectability ■ Sensitivity and robustness ■ Part III. Digital control designs ■ Indirect approach by approximating analog control ■ Direct approaches like pole-placement control 目標： ■ The students are expected to learn how to analyze the dynamic behavior of an LTI discrete-time system and design effective digital control for such system. The analysis and design will be conducted in both time- and frequency-domains.						
教科書	■ 自編講義 ■ Norman S. Nise, Control Systems Engineering, 6th ed., John Wiley & Sons, Inc., 2011, Chap 13 ■ Karl J. Astrom and Bjorn Wittenmark, Computer-Controlled Systems – Theory and Design, 3rd ed., Prentice-Hall, 1997					
課程大綱			分配時數			
單元主題	內容綱要	講授	示範	習作	其他 ¹	可達成核心能力
Overview of digital control design	1. Providing an overview of digital control 2. Highlighting the continuation from undergraduate automatic control class to this digital control class	9				D01, D02

Modeling of discrete-time systems	1. Difference equations 2. Z-transform	9				D01, D02
Analysis of discrete-time systems	1. Stability 2. Transient analysis 3. Controllability and observability 4. Sensitivity and robustness	18				D01, D02, D04
Discrete control design	1. Indirect designs by approximating analog control 2. Direct designs of digital control	12				D01, D02, D04
可達成核心能力		核心能力達成指標				
D01	具機械領域之專業知識	具備分析數位系統以及設計數位控制的能力				
D02	策劃及執行機械及其相關領域專題研究之能力	具備策劃及執行數位控制及其相關領域專題研究之能力				
D04	創新思考及獨立解決機械問題之能力	具備獨立分析並解決數位控制相關問題之能力				

教學要點概述:

上課時間	上課地點	學習成果評量方式	Office hour	教學品質評量方式
四 7-9	工學院 B 館 213	4 exams (3 midterms + 1 final) & several quizzes - Grade of each exam will be adjusted individually - Score 1= average of the final and the best 2 of the 3 midterms - Score 2 = min(final, 75) - Score 3 = max(score1, score2) - If absences ≤ 3 Score 4 = 5 - else Score 4 = 0 - Score 5 = average(quizzes) - If Score 3 ≥ 70, final grade = Score 3 - elseif (Score 3 + Score 4) ≥ 70, final grade = 70 - else final grade = min(Score3+Score4+Score5*0.1, 70)	星期五 19:00-21:00	教學意見調查核心能力重要性及達成度分析問卷

週次	教學與作業進度	備註
1	Pt 0. Overview of digital control design	
2	Pt 0. Overview of digital control design	
3	Pt 0. Overview of digital control design	
4	Pt 1. Difference equations	
5	Pt 1. Z-transform	
6	Pt 1. Z-transform	
7	Holiday	
8	Pt 2. Stability	
9	Pt 2. Transient analysis	
10	Pt 2. Transient analysis	
11	Pt 2. Controllability and stabilizability	
12	Pt 2. Observability and detectability	
13	Pt 2. Sensitivity and robustness	
14	Pt 2. Sensitivity and robustness	
15	Pt 3. Indirect digital control design	
16	Pt 3. Direct digital control design	
17	Pt 3. Direct digital control design	
18	Final exam	