

**CP-417 DIGITAL CONTROL SYSTEM COURSE PLAN**  
**Spring Semester 2011**

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Chapter	Contents	Week (date)
<b>1. Introduction to discrete time system and Z-transform</b>	An overview of Digital Control system, Control problem, discrete-time systems, Z-transform and inverse Z-transform method and properties. Mapping of S-plane to Z-plane.	<b>( week 1) 10-02-2011</b>
<b>2. Sampling and Data Reconstruction</b>	Sampling theorem, sampling process, mathematical modeling of sampling process, data construction, holding circuits (ZOH&FOH). Sampling rate selection.	<b>(week 2 - 3)</b>
<b>Quiz 1 (Lecture# 01)</b>		
<b>3. Discrete Time system modeling</b>	Discretization of Continuous System, Solution to difference equations, simulation diagrams and flow graphs, state variables, pulse transfer function.	<b>(week 3 - 4)</b>
<b>Assignment 1(Problems)</b>		
<b>4. Open-loop systems</b>	Analysis of open-loop system with digital filters and time delays. Techniques for finding discrete state-variable models of open-loop sampled-data systems.	<b>(week 5 - 6)</b>
<b>Quiz 2 (Lecture# 02 &amp; 03)</b>		
<b>5. Closed-loop systems</b>	Derivation procedure of digital system transfer function by using the discretization technique, signal flow graph method, using Mason's Gain formula.	<b>(Week 7 - 8)</b>

### After Mid-Term

Chapter		Teaching Contents	Duration/time
STABILITY ANALYSIS TECHNIQUES	Stability concept	To understand the basic theorems of stability for digital control systems for linear time-invariant discrete time systems.	(week 9)
	Bilinear transformation	To be able to apply this transformation technique to study the system stability by means of frequency response method	
	Routh-Hurwitz Criterion	To be able to analyze system stability by using Routh-Hurwitz Criterion. However, bilinear transformation need to be applied first before using the Routh-Hurwitz	
	Jury Stability	To be able to use Jury's stability test method to determine stability of a system. This is method does not require bilinear transformation.	
	<b>Assignment 2 and Mid Term Paper discussion</b>		
	Root Locus	To be able to use root locus technique to analyze a system stability by plotting the root locus with respect to z-plane. Bilinear transformation is not required.	(Week 10-11)
	Bode Diagram	To be able to use Bode Plot or diagram as one of the frequency response method to study the stability of a system. However, a bilinear transformation performed on the transfer function of the system of interest is required.	
	Nichols Chart	To be able to use Nichols Chart to study the system's closed-loop frequency response.	
	<b>Quiz 3 (Stability Analysis)</b>		
DIGITAL CONTROLLER DESIGN	Overview of system performance specification	To get to know the control system specification before designing digital controller.	(Week 12)
	Phase-lag controller	To be able to know the procedure of phase-lag compensation and later applied in the design stage of digital controller	
	Phase Lead controller	To be able to know the procedure of the phase-lead compensation and later applied in the design stage of digital controller.	

	Lead-Lag controller	To be able to combine the advantages of both phase-lead and phase-lag controller into one controller called as lag-lead controller	<b>(Week 13-14)</b>
		<b>Assignment 3</b>	
	Digital controllers	Realization of digital controllers by digital programming, direct digital programming, Cascade digital programming and parallel digital programming,	<b>(Week 14-15)</b>
		<b>TEST</b>	<b>Week 16</b>

Subjected to Time Constraint.

**Reference:**

1. Phillips C.L. and Nagle H.T., "Digital Control System Analysis and Design", 3rd ed., Prentice Hall, 1995.
2. Katsuhiko Ogata, "Discrete-Time Control System", 2<sup>nd</sup> ed., Prentice Hall, 2006.
3. Franklin G.F., Powell J.D and Workman M.L., "Digital Control of Dynamic Systems ", 3rd ed., Addison Wesley, 1997.
4. Paraskevopoulos P.N., "Digital Control Systems", Prentice Hall, 1996.

### Marks distribution

<b>Assignments</b> There will be 3 assignments. All 3 assignments are counted.	10%
<b>Quizzes</b> There will be 3 quizzes in total. There will be some pop quizzes from time to time. Please be prepared and present in the lecture.	10%
<b>Midterm Test</b>	20%
<b>Final Exam</b>	60%
<b>TOTAL</b>	<b>100%</b>