Digital Control System - Web course

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Electrical Engineering

COURSE OUTLINE

The core course in electrical engineering introduces the fundamental concepts, principles and application of digital control system analysis and design to the postgraduate students.
The course material are prepared in such a manner so that it will be very useful not only for students of postgraduate program in control systems but also for final year undergraduate students, post-graduate students, teachers and practitioners.
This course goes deeper into the various aspects of digital control engineering. Each topic is developed in logical progression with up-to-date information.
The topics cover classical control design methods as well as the modern control design techniques. A number of chosen problems are solved to illustrate the concepts clearly. A suite of exercises is also provided in the appendix after each module.

COURSE DETAIL

Module No.	Sl. No.	Module/ Lecture Topics	No. of (Total) Hours
1		Introduction to digital control	04
	Lecture 1	Introduction	
	Lecture 2	Discrete time system representation	
	Lecture 3	Mathematical modeling of sampling process	
	Lecture 4	Data reconstruction	
2		Modeling discrete-time systems by pulse transfer function	05
	Lecture 1	Revisiting Z-transform	
	Lecture 2	Mapping of s-plane to z-plane	
	Lecture 3	Pulse transfer function	
	Lecture 4	Pulse transfer function of closed loop system	
	Lecture 5	Sampled signal flow graph	

Pre-requisites:

1. Control Systems Engineering - I.

Coordinators:

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3		Stability analysis of discrete time systems	**02**
	Lecture 1	Jury stability test	
	Lecture 2	Stability analysis using bi-linear transformation	
4		Time response of discrete systems	**02**
	Lecture 1	Transient and steady state responses	
	Lecture 2	Time response parameters of a prototype second order system	
5		Design of sampled data control systems	**08**
	Lecture 1	Root locus method	
	Lecture 2	Controller design using root locus	
	Lecture 3	Root locus based controller design using MATLAB	
	Lecture 4	Nyquist stability criteria	
	Lecture 5	Bode plot	
	Lecture 6	Lead compensator design using Bode plot	
	Lecture 7	Lag compensator design using Bode plot	
	Lecture 8	Lag-lead compensator design in frequency domain	
6		Deadbeat response design	**03**
	Lecture 1	Design of digital control systems with deadbeat response	

	Lecture 2	Practical issues with deadbeat response design	
	Lecture 3	Sampled data control systems with deadbeat response	
7		Discrete state space model	**04**
	Lecture 1	Introduction to state variable model	
	Lecture 2	Various canonical forms	
	Lecture 3	Characteristic equation, state transition matrix	
	Lecture 4	Solution to discrete state equation	
8		Controllability, observability and stability of discrete state space models	**03**
	Lecture 1	Controllability and observability	
	Lecture 2	Stability	
	Lecture 3	Lyapunov stability theorem	
9		State feedback design	**04**
	Lecture 1	Pole placement by state feedback	
	Lecture 2	Set point tracking controller	
	Lecture 3	Full order observer	
	Lecture 4	Reduced order observer	
10		Output feedback design	**02**
	Lecture 1	Output feedback design: Theory	
	Lecture 2	Output feedback design: Examples	

11		Introduction to optimal control	03
	Lecture 1	Basics of optimal control	
	Lecture 2	Performance indices	
	Lecture 3	Linear Quadratic Regulator (LQR) design	

References:

1. B. C. Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition, 2007.
2. K. Ogata, Discrete Time Control Systems, Prentice Hall, 2/e, 1995.
3. M. Gopal, Digital Control and State Variable Methods, Tata Mcgraw Hill, 2/e, 2003.
4. G. F. Franklin, J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems,
5. Addison Wesley, 1998, Pearson Education, Asia, 3/e, 2000. K. J. Astroms and B. Wittenmark, Computer Controlled Systems - Theory and Design, Prentice Hall, 3/e, 1997.