WEST VIRGINIA UNIVERSITY
COLLEGE OF ENGINEERING AND MINERAL RESOURCES
DEPARTMENT OF COMPUTER SCIENCE AND ELECTRICAL ENGINEERING

EE 413 INTRO TO DIGITAL CONTROL FALL 2014
3 credit Hours

Instructor: Dr. M.A. Choudhry, 931 Engineering Sciences Building
Phone: 293-9685
Email: machoudhry@mail.wvu.edu

Office Hours: MW 4:00-5:00 (or by appointment)

Class Time: MWF 15:00- 15:50 Class Location: 201 ESB

Prerequisites: EE and CpE Signals and Systems' Required Courses

Text: Digital Control of Dynamic Systems, Franklin, Powell, Workman, Addison Wesley Longman, Inc.

References:

Digital Control:

Digital Control Systems: Theory, Hardware, Software, by Houpis and Lamont, Copywright 1992, McGraw-Hill, Inc., ISBN # 0-07-030500-5

Continuous Time Systems/Fundamentals of Control:

Ogata, K., Modern Control Engineering, third Edition, C 1997, Prentice-Hall

Automatic Control Systems, Seventh Edition, by B.C. Kuo, Prentice-Hall, 1995

Linear Systems and Signals, by B. P. Lathi, Berkeley-Cambridge Press, 1998

Linear Control Systems, by Rohrs, Melsa and Schultz, McGraw Hill, 1993

Modern Control Theory, Third Edition, Brogan, W.L., Prentice-Hall, 1991

CATALOG DESCRIPTION:

Sampling of continuous-time signals and transform analysis. State variable analysis for linear discrete-time systems and design of digital controllers.

Electrical Engineering program Outcomes to which this course contributes:

1. Be able to understand how dynamic systems are represented/modeled mathematically.
2. Be able to write equations which represent specific systems.
3. Be able to understand the differences between continuous and discrete time system models in some detail.
4. Be able to apply tests for stability in both continuous and discrete domains to determine system stability.
5. Be able to apply design analysis tools such as root locus and frequency response to both analog and digital systems.
6. Be able to understand and apply feedback to achieve stable controlled systems and to meet required design specifications
7. Be able to effectively use digital control devices (computers) to design stable, closed-loop feedback systems.
8. Be able to effectively employ powerful contemporary tools such as Matlab to aid in achieving the control design and implementation outcomes listed above.

Course Contents:

INTRODUCTION

REVIEW OF CONTINUOUS CONTROL

Representation of Systems

Differential equations , Transfer functions, Block diagrams

Response Signals from Systems

Time domain, Frequency domain

Feedback

Properties, Stability, Steady State Error

Root Locus

Construction, Computational Aids: Matlab

Frequency Response

Bode Plots, Matlab, Stability Margins: Gain and Phase Margins
Compensators (controllers)
State Space Representation and State Feedback
INTRODUCTION TO DIGITAL CONTROL
Discretization, Sampling effects
DISCRETE SYSTEMS ANALYSIS
Representation of Systems
Difference equations, Transfer functions, Block diagrams, Z Transforms
Discrete Models of Sampled-Data Systems using Z Transform
Signal Analysis and Dynamic Response
(to a) Unit pulse, Unit step, Other input forms
Frequency Response
Z Transform and its Properties
SAMPLED-DATA SYSTEMS
Sample and Hold, Block Diagrams for Sampled-Data Systems
DISCRETE EQUIVALENTS
Using Numerical Integration, Zero-Pole Matching Equivalents
Holds: Zero Order, Others
DESIGN: FREQUENCY DOMAIN
By Emulation, By Root Locus, By Frequency Response
By Other Fequency Domain Methods
OTHER DESIGN APPROACHES: TIME DOMAIN, STATE-SPACE

HOMEWORK:

Homework assigned will be due and collected at the beginning of class. Most of it will be graded. No late homework will be accepted. Ask questions on homework in class. Individual questions should be covered during office hours in my office.

Do all homework on clean (cut) edged 8 1/2 x 11" paper, one side only. Start each new item (e.g. problem, question, etc.) on a new sheet. **Staple** all pages of each homework **set together**.

On the **top** (cover) **sheet** of the set, **write**:

Your name
The homework set number
The date due

Write your name on every sheet of paper.

Several in class quizzes will be given over one to two week segments of material.

If you know you **must miss** a future class, all homework is due before (or on) the due date. Credit cannot be given for late homework.

If you must **miss** class **due to emergency** reasons (sickness, death in family, etc.), call (or have someone else call) the instructor or leave a phone message at the phone number given above.

GRADING:

Homework	15%
Unannouced Quizzes	10%
Two Exams	50%
Final Exam (Comprehensive)	25%
	100% Total

Academic Integrity Statement:

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at http://www.arc.wvu.edu/admissions/integrity.html. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me *before* the assignment is due to discuss the matter.

WVU is committed to social justice. The instructor of this course concurs with WVU's commitment and expects to maintain a positive learning environment based upon open communication and mutual respect and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color, or national origin. Any suggestions as to how to further such a positive and open environment will be appreciated and given serious consideration.
If you are a person with disability and anticipate needing any type of accommodation in order to participate in this class, please advise us and make appropriate arrangements with Disability Services (293-6700).