METROPOLITAN STATE UNIVERSITY OF DENVER
Office of Academic and Student Affairs

REGULAR COURSE SYLLABUS

College of: Professional Studies

Department: Engineering and Engineering Technology

Prefix & Course Number: CPE 4710 **Crosslisted With*:** _____

Course Title: Digital Control System Design

Transcript Course Title (30 characters): Digital Control System Design

Check All That Apply: Required for Major:___ Required for Minor:_____ Specified Elective: X

Required for Concentration: _____ Elective: Service Course: _____

To receive Title IV financial aid funds, all institutions of higher education must comply with the federal definition of a credit hour. The Higher Learning Commission requires institutions to maintain policies and procedures for verifying compliance with this definition.

> ***Federal Credit Hour Definition:*** *A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally-established equivalency that reasonably approximates not less than:*
> *(1) one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or (2) at least an equivalent amount of work as required in paragraph (1) of this definition for other activities as established by an institution, including laboratory work, internships, practica, studio work, and other academic work leading toward to the award of credit hours. 34CFR 600.2 (11/1/2010)*

Credit Hours: 4 (4+0) **Schedule Type**: L **Grade Mode**: L

Face-to-Face or Equivalent Hours per course:

Lecture 60 Lab __ Internship _____ Practicum _____ Other (please specify type and hours):_____

Additional Student Work Hours per course: 120

Variable topics umbrella course: **No** X **Yes** _____ If yes, number of credits/repeats allowed _____

Specified repeatable course: **No** X **Yes** _____ If yes, number of credits/repeats allowed _____

Prerequisite(s): CPE 3715 (with a grade of "C" or better for all prerequisites)

Corequisite(s): _____

Prerequisite(s) or Corequisite(s): _____

APPROVED:

Department Chair **OR** Program Director Date

Dean **OR** Associate Dean Date

Associate VP, Academic and Student Affairs Date

*If crosslisted, attach completed Course Crosslisting Agreement Form

Prefix and Course Number:

Banner Enforced Coding:
Prerequisite(s): CPE 3715 (with a grade of "C" or better for all prerequisites)
Corequisite(s): _____
Prerequisite(s) or Corequisite(s): _____

Registration restrictions: Level _____ Class _____Program/Major _____ Student attribute _____

Catalog Course Description:
Students in this course will learn the process and theory of the design of digital control systems, using classical and modern control theory. State variable feedback control and other optimal control theories will be covered.

Specific Variable Topics Course Description (if applicable, umbrella course description included above):

Required Reading and Other Materials will be equivalent to:
Phillips (2014). *Digital Control System Analysis & Design, 4th edition* or latest edition. Upper Saddle Hill, NJ: Prentice Hall.

Specific, *Measurable* Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. Analyze both classical and modern digital control systems
    a. Develop competency in the use of the z-transform as an analysis tool
    b. Determine stability of systems through a wide variety of techniques
2. Develop methods for stable design of digital control systems
    a. Use a variety of discrete mathematical techniques for digital control system design
    b. Develop an understanding of the applications of digital control systems
3. Design a variety of digital control systems
    a. Pole-placement technique
    b. State variable feedback control systems
    c. State observers control systems
    d. Fuzzy logic control systems.

Detailed Outline of Course Content (Major Topics and Subtopics) **or Outline of Field Experience/Internship (experience, responsibilities and supervision):**

I. Introduction to Digital Control

II. Z-Transform
    A. Discrete-time Systems
    B. Transform Methods
    C. Theorems of Z-transform
    D. Solution of Difference Equations
    E. Inverse Z-transform

III. Sampling
    A. Ideal Sampler
    B. Practical Sampler
    C. Sampled Control Systems
    D. Data Reconstruction
    E. A/D and D/A (brief)
    F. Alias Filter Design

IV. Time Response
- A. System Time Response
- B. Characteristic Equation
- C. Analog s-plane/Digital z-plane Mapping
- D. Steady-State Accuracy

V. Stability Analysis
- A. Introduction
- B. Bilinear Transformation

VI. Frequency Response

VII. Robustness

VIII. State Variable Model
- A. Pole Placement Design
- B. State Estimation
- C. Observer Design
  - 1. Full-Order
  - 2. Reduced-Order
- D. Controllability and Observability
- E. Integral State Feedback

IX. Optimal Control (brief)

X. Fuzzy Logic
- A. Concepts
- B. Design

Evaluation of Student Performance:

1. Examinations
2. Written Assignments