METROPOLITAN STATE COLLEGE *of* DENVER
Office of Academic Affairs

# REGULAR COURSE SYLLABUS

**School of:** Professional Studies

**Department:** Engineering Technology

**CIP Code:** 15.0303

**Prefix & Course Number:** EET 4320 **Crosslisted With*:** _____

**Course Title**: Digital Filters

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

Required for Concentration: _____ Elective: X Service Course: _____

**Credit Hours**: 3 (2+2)

**Total Contact Hours per semester (assuming 15-16 week semester):**

Lecture 30 Lab 30 Internship _____ Practicum _____ Other (please specify type and hours):_____

**Schedule Type(s)**: B **Grading Mode(s)**: L

**Variable Topics Courses** (list restrictions, including the maximum number of hours that can be earned**):

____

** **NOTE: This information must be included in the course description.**

**Restrictions (Variable Topics Course)**: _____

**Prerequisite(s):** EET 2340, and EET 3110, with grades of "C" or better.

**Corequisite(s)**: _____

**Prerequisite(s) or Corequisite(s):** _____

**Banner Enforced:**

**Prerequisite(s)**: EET 2340, and EET 3110, with grades of "C" or better.
**Corequisite(s)**: _____
**Prerequisite(s) or Corequisite(s):** _____

**Catalog Course Description:**
This course introduces digital filters as applied in digital signal processing and sampled data control systems.

APPROVED:

Department Chair **OR** Program Director — Date 12 Feb 08

Dean **OR** Associate Dean — Date 2/13/08

Associate VP, Academic Affairs — Date 3/7/08

*If crosslisted, attach completed Course Crosslisting Agreement Form

EET 4320:

**Required Reading and Other Materials will be equivalent to:**

Mcclellan, Schafer, Yoder (December 30, 1997). *DSP First: A Multimedia Approach, 1st Edition.* Prentice Hall

**Specific, *Measurable* Student Behavioral Learning Objectives:**

Upon completion of this course the student should be able to:

1. Determine when to choose digital or analog filters using criteria such as:
   a. Content of noise spectra
   b. Distance between analog data and the computer
   c. Likelihood of design change
   d. Cost of components vs. cost of software development
   e. Time available for processing results
2. Design simple classical filters, which are recursive.
3. Apply computer programs to accomplish:
   a. Fourier analysis
   b. Fast Fourier Transform
   c. Discrete Fourier Transform
   d. Power Spectra

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

I. Sinusoids:
   A. Review of Sine and Cosine Functions
   B. Sinusoidal Signals
   C. Sampling and Plotting Sinusoids
   D. Complex Exponentials and Phasors
   E. Phasor Addition

II. Spectrum Representation:
   A. The Spectrum of a Sum of Sinusoids
   B. Periodic Waveforms
   C. Time-Frequency Spectrum
   D. Frequency Modulation: Chirp Signals

III. Sampling and Aliasing:
   A. Sampling
   B. Spectrum View of Sampling
   C. Strobe Demonstration
   D. Discrete-to-Continuous Conversion
   E. The Sampling Theorem

IV. FIR Filters:
   A. Discrete-Time Systems
   B. The General FIR Filter
   C. Implementation of FIR Filters
   D. Linear Time-Invariant (LTI) Systems
   E. Convolution and LTI Systems

V. Frequency Response of FIR Filters:
   A. Sinusoidal Response of FIR Systems
   B. Steady State and Transient Response
   C. Graphical Representation of the Frequency Response
   D. Filtering Sampled Continuous-Time Signals

VI. z-Transforms:
   A. Definition of the z-Transform
   B. Properties of the z-Transform
   C. The z-Transform as an Operator
   D. Convolution and the z-Transform
   E. Relationship between the z-Domain and the w-Domain
   F. Useful Filters
   G. Practical Bandpass Filter Design

VII. IIR Filters:
   A. The General IIR Difference Equation
   B. Time-Domain Response
   C. System Function of an IIR Filter
   D. Poles and Zeros
   E. Frequency Response of an IIR Filter
   F. The Inverse z-Transform and Some Applications

VIII. Spectrum Analysis:
   A. Spectrum Analysis by Filtering
   B. Spectrum Analysis of Periodic Signals
   C. Spectrum Analysis of Sampled Periodic Signals
   D. Spectrum Analysis of Nonperiodic Signals
   E. The Fast Fourier Transform (FFT)

NOTE: MATLAB will be used in this course.

**Evaluation of Student Performance:**

1. Written exams
2. Written homework
3. Computer programs