

**ABET COURSE SYLLABUS**

**ECSE-4510: Discrete-Time Systems**

- Course Catalog Description:** Sampling, quantization, reconstruction of signals. Digital filters. Mathematical tools used in the modeling, analysis, and synthesis of discrete-time communication and control systems. These include discrete Fourier transform, z-transform, state-variable, and transfer-function techniques. Applications to sampled-data control and quantized-data communications systems. Fall term annually. 3 credit hours
- Pre-Requisite Courses:** ECSE-2410 Signals and Systems
- Co-Requisite Courses:** None
- Prerequisites by Topic:**
1. Properties of continuous and discrete-time signals
  2. Fourier series and transforms; Laplace transforms
  3. Time- and frequency-domain linear systems analysis
  4. Transfer functions, impulse response, step response
- Textbook:** Phillips and Nagle, Digital Control System Analysis and Design, 3<sup>rd</sup> Ed., Prentice Hall, 1995  
(and/or other required material)
- References:** None
- Course Coordinators:** Murat Arcak, Joe Chow, Lester Gerhardt
- Overall Educational Objective:** The overall objective of this course is to introduce students to the fundamental principles of discrete-time system analysis and design.
- Course Learning Outcomes:**
1. Understand and apply z-transform, state-space, and simulation diagram representations of linear difference equations
  2. Understand and apply transforms of discrete-time signals
  3. Understand the fundamental principles of sampling, reconstruction, and quantization
  4. Design digital control systems to meet frequency- or time-domain closed-loop specifications
  5. Design digital filters to meet frequency-domain specifications
- How Course Outcomes are Assessed:** This course is delivered in lecture format. Homework assignments are assigned on a weekly basis. Two computer projects are assigned. The grade is determined as follows: Homework sets 20% total; 2 computer projects 5% each; 2 tests 20% each, and final (30%).

**Relation to EE/CSE/EPE Outcomes**

**N = none**  
**M = moderate**  
**H = high**

Outcome	Level	Demonstrate Proficiency
	N, M, H	e.g. Exams, projects, HW
Mathematics, science and engineering	H	Projects, HW, exams
Basic disciplines in Electrical Engineering	N	
Depth in Electrical Engineering	H	Projects, HW, exams
Basic disciplines in Computer & Sys. Eng.	N	
Depth in Computer and Systems Eng.	H	Projects, HW, exams
Electromagnetics, electromechanics, power semiconductors	N	
Power system behavior	N	
Electrical energy conversion	N	
Conduct experiments and interpret data	N	
Identify, formulate and solve problems	H	Projects, HW, exams

Design a system, component or process	M	Projects, HW, exams
Communicate in written and oral form	N	
Function as part of a multi-disciplinary team	N	
Preparation for life-long learning	N	
Ethical issues; safety, health, public welfare	N	
Humanities and social sciences	N	
Laboratory equipment and software tools	N	
Variety of instruction formats	N	

**Topics Covered:**  
**(number of hours or classes for each)**

1. Difference equations and z-transforms (2)
2. State-space representations (2)
3. Transfer functions (1)
4. Sampling (1)
5. Open-loop pulse transfer functions (1)
6. Discrete-time state-space models for sampled continuous-time systems (1)
7. Closed-loop pulse transfer functions and state-space models (1)
8. A/D and D/A conversion (1)
9. Reconstruction and quantization (2)
10. Time-domain systems response (1)
11. Characteristic equations and stability (1)
12. Bode plots (1)
13. Design specifications for control systems (1)
14. Digital control design (2)
15. Sampled-data transformation (1)
16. Discrete Fourier series, DTFT, DFT, FFT (2)
17. IIR filter design (1)
18. FIR filter design and tapered windows (1)
19. Digital filter structures (1)
20. Direct digital filter implementation (1)
21. Digital communication systems and applications (2)

**Computer Usage:**

MATLAB for homework and project assignments

**Laboratory Experiences:**

None

**Design Experiences:**

The projects incorporate design

**Independent Learning Experiences:**

None

**Class/Lab Schedule:**

MR 8:30 – 9:50 AM

**Contribution to the  
Professional Component:**

- |                                                   |                  |
|---------------------------------------------------|------------------|
| (a) College-level mathematics and basic sciences: | 0.5 credit hours |
| (b) Engineering Topics (Science and/or Design):   | 2.5 credit hours |
| (c) General Education:                            | 0 credit hours   |

<b>Prepared by:</b>	Murat Arcak
<b>Date:</b>	4/7/2006