EE 3372 - Introduction to Digital Signal Processing
Fall 2010

Course Catalog Description:

This course is designed to give juniors a thorough understanding of techniques needed for the analysis of discrete-time signals and systems. Topics include Fourier methods and *z*-transform techniques, the discrete Fourier transform, the fast Fourier transform and applications such as digital filters. *Prerequisites:* EE 2370 and EE 2170.

Time: TuTh 09:30-10:50
Location: Caruth 184

Instructor: Panos Papamichalis
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E-mail: panos@engr.smu.edu
Office hours: Tue-Wed-Thu 11:00 AM-12:00 PM

Teaching Assistant/Grader: TBA

Textbook:

B.P. Lathi, *Linear Systems and Signals*, Oxford University Press, Second Edition, 2005

References:

Charles L. Phillips, John M. Parr, Eve A. Riskin, *Signals, Systems, and Transforms*, Prentice-Hall, Fourth Edition, 2007
Alan V. Oppenheim, Ronald W. Schafer, John R. Buck, *Discrete-Time Signal Processing*, Prentice-Hall, Second Edition, 1999
Monson H. Hayes, *Digital Signal Processing*, Schaum's Outline, McGraw-Hill, 1998
John G. Proakis, Dimitris K. Manolakis, *Digital Signal Processing*, Prentice-Hall, Fourth Edition, 2006

Course Topics:

1. Discrete-Time Signals and Signal Operations
2. Time-Domain Analysis of Discrete-Time Signals
3. Discrete-Time Convolution
4. The *z*-Transform
5. Transfer Functions and Partial Fraction Expansions
6. Poles and Zeros: Stability of LTI Systems
7. Signal Reconstruction and Sampling
8. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)
9. Applications in Digital Filtering

Grading Policy:

Homework Assignments 15%

Three Mid-Term Exams: 20% each

Final Exam: 25%

Undergraduate Program Outcomes (Emphasis: EE 3372)

Program outcomes are statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their matriculation through the program.

Outcome (A): ***Ability to apply knowledge of mathematics, science, and engineering***

Performance Criteria		Unsatisfactory 1	Developing 2	Satisfactory 3	Exemplary 4
A.1	**Turn a problem statement into an analytical model**	Cannot connect problem statements to analytical model.	Can interpret parts of the problem analytically, but cannot find a complete solvable approach.	Can find some way(s) to formulate the problem, but not always the most direct.	Can quickly find an efficient clear and precise analytical representation of the problem statement
A.2	**Identify appropriate method for solving specified problem**	Identifies inappropriate methods or no method at all.	Identifies a related technique for part of the problem.	Identifies an appropriate method.	Identifies an innovative and effective method.
A.3	**Execution of method**	Cannot solve a mathematically posed relationship.	Can take several steps towards the solution, but not complete it.	Arrives at the correct answer through a rather indirect path.	Quickly finds an innovative way to solve the problem.

Rubric for Outcome (C): ***Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability***

Performance Criteria		Unsatisfactory 1	Developing 2	Satisfactory 3	Exemplary 4
C.1	**Derive design requirements from the problem statement that meet desired needs**	Derives at most one primary design requirement for a given problem statement.	Derives less than half of the primary design requirements for a given problem statement.	Derives the primary set of design requirements for a given problem statement.	Derives all of the design requirements for a given problem statement.

C.2	**Identifies relevant, realistic design constraints from the problem statement**	Identifies at most one of the primary relevant, realistic design constraint for a given problem statement.	Identifies less than half of the primary relevant, realistic design constraints for a given problem statement.	Identifies the primary relevant realistic design constraints for a given problem statement.	Identifies all of the relevant, realistic design constraints for a given problem statement.
C.3	**Rank orders a set of design constraints in order of priority with justification**	Can identify at most one of the primary relevant, realistic design constraint for a given problem statement.	Correctly rank orders less than half of the primary design constraints with modest justification for a given problem statement.	Correctly rank orders the primary design constraints with acceptable justification for a given problem statement.	Correctly rank orders all design constraints with excellent justification for a given problem statement.
C.4	**Produces a design that satisfies design requirements within relevant realistic constraints**	Produces a design that satisfies at most one primary design requirement with at most one of the primary relevant, realistic design constraints satisfied for a given problem statement.	Produces a design that satisfies less than half of the primary design requirements with less than half of the primary relevant, realistic design constraints satisfied for a given problem statement.	Produces a design that satisfies more than half of the primary design requirements with more than half of the primary relevant, realistic design constraints satisfied for a given problem statement.	Produces a design that satisfies almost all primary design requirements with almost all primary relevant, realistic design constraints satisfied for a given problem statement.

Outcome (E): ***Ability to identify, formulate, and solve engineering problems***

Performance Criteria		**Unsatisfactory 1**	**Developing 2**	**Satisfactory 3**	**Exemplary 4**
E.1	**Problem Identification**	Unable to perceive that there is a problem.	Observes that there is a problem but lacks ability to articulate it.	Can identify and describe the problem.	Can identify not only the evident problem but also any related problems.
E.2	**Problem Formulation**	Unable to formulate the problem.	Can partially formulate the problem.	Can formulate the problem.	Can quickly find an efficient formulation of the problem
E.3	**Problem Solving**	Unable to solve the problem.	Can take several steps towards the solution, but not complete it.	Arrives at the correct answer.	Efficiently arrives at the correct answer.

E.4	**Trouble Shooting**	Unable to narrow down symptoms	Isolates problem to an specific area but does not identify causal mechanism	Able to isolate and solve problem	Develops structured and efficient method that results in solution

Some Rules and Expectations:

- Homework assignments are due at the end of the lecture on the due date (typically, one week after they are assigned).
- No late homework will be accepted without prior notification.
- Adherence to the SMU Honor Code will be strictly enforced.
- Please arrive and exit class on time, as late arrivals and early exits can be a distraction to others.
- Do not use cell phones or other communications devices while in class.
- Participation in class discussions and public questions about class material are encouraged; private conversations during the lecture are discouraged.
- One page, hand-written note sheets will be allowed on each test. Your work area during the test should otherwise be completely cleared of books and additional notes.

Homework self-grading:

You will be grading your own homework, in order to better understand what you did right or wrong. The grading will be done according to the following guidelines:

- Before you turn in your homework on the due date, make a photocopy of the homework and keep either the original or the photocopy for self grading.
- When you turn in your homework, the solutions will be given to you.
- Grade your homework based on the solutions.
    - For each problem, give a grade between zero and the maximum number of points indicated in the homework assignment. Round any fractional grade to the nearest integer.
    - For a problem with different parts, divide the total number of points equally between the parts.
    - If you have to subtract points from a problem, write on your homework what you did wrong.
    - If you make a mistake in a problem and there is a follow-up question depending on this (mistaken) outcome, subtract the appropriate points from the first question, but assume that it is correct when grading the follow-up question.
    - If you have a different approach from the solutions but you claim they are equivalent, verify that you get the same results. If you do, write a note on that and give yourself full credit.
    - For EACH problem, round your grade to the nearest integer. Assign a number grade to each problem; do not just give the points you subtract.
- The grading should reflect your level of understanding of the concepts. For instance, if you have a "+" sign in an expression instead of a "-" sign because you copied it wrong, this is a small mistake. But if you have the same sign change because you did not understand what the operation does, this is a serious mistake.

- The graded papers are due at the following lecture.
- I reserve the right to adjust your self-grade, if necessary.

Incomplete Policy:

An Incomplete(I) may be given if the majority of the course requirements have been completed with passing grades but for some justifiable reason acceptable to the instructor, the student has been unable to complete the full requirements of the course. Before an (I) is given, the instructor should stipulate in writing to the student the requirements and completion date that are to be met and the grade that will be given if the requirements are not met by the completion date. The maximum period of time allowed to clear the Incomplete grade is 12 months (except for graduate thesis and dissertation courses.) If the Incomplete grade is not cleared by the date set by the instructor or by the end of the 12-month deadline, the (I) may be changed to an F, WP or other grade, each of which is prescribed for other specific purposes. If the student's work is incomplete and the quality has not been passing, an F will be given. The grade of (I) does not authorize the student to attend the course during a later semester. Graduation candidates must clear all Incompletes prior to the deadline in the University Calendar, which may allow less time than 12 months. Failure to do so can result in removal from the degree candidacy list and/or conversion of the (I) to the grade indicated by the instructor at the time the (I) was given.

Disability Accommodations:

If you need academic accommodations for a disability, you must first contact Disability Accommodations & Success Strategies (DASS) at 214-768-1470 or www.smu.edu/alec/dass.asp to verify the disability and to establish eligibility for accommodations. Then you must schedule an appointment with the professor to make appropriate arrangements.

Religious Observance:

Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy No. 1.9.)

Excused Absences for University Extracurricular Activities:

Students participating in an officially sanctioned, scheduled University extracurricular activity will be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (University Undergraduate Catalog)

Academic Honesty

Academic dishonesty may be defined broadly as a student' misrepresentation of his or her academic work or of the circumstances under which the work is done. This includes

plagiarism in all papers, projects, take-home exams, or any other assignments in which the student represents work as being his or her own. It also includes cheating on examinations, unauthorized access to test materials, and aiding another student to cheat or participate in an act of academic dishonesty. Failure to prevent cheating by another may be considered as participation in the dishonest act.

The SMU Honor Code (http://www.smu.edu/studentlife/PCL_05_HC.asp) states:
"Intellectual integrity and academic honesty are fundamental to the process of learning and of evaluating academic performance, and maintaining them is the responsibility of all members of an educational institution. The inculcation of personal standards of honesty and integrity is a goal of education in all the disciplines of the University. The faculty has the responsibility of encouraging and maintaining an atmosphere of academic honesty by being certain that students are aware of the value of it, that they understand the regulations defining it, and that they know the penalties for departing from it. The faculty should, as far as is reasonably possible, assist students in avoiding the temptation to cheat. Faculty members must be aware that permitting dishonesty is not open to personal choice. A professor or instructor who is unwilling to act upon offenses is an accessory with the student offender in deteriorating the integrity of the University. Students must share the responsibility for creating and maintaining an atmosphere of honesty and integrity. Students should be aware that personal experience in completing assigned work is essential to learning. Permitting others to prepare their work, using published or unpublished summaries as a substitute for studying required materials, or giving or receiving unauthorized assistance in the preparation of work to be submitted are directly contrary to the honest process of learning. Students who are aware that others in a course are cheating or otherwise acting dishonestly have the responsibility to inform the professor and/or bring an accusation to the Honor Council. Students and faculty members must mutually share the knowledge that any dishonest practices permitted will make it more difficult for the honest students to be evaluated and graded fairly and will damage the integrity of the whole University. Students should recognize that both their own interest, and their integrity as individuals, suffers if they condone dishonesty in others."

Calendar:

August 24	First Day of Classes
(September 23)	(First Mid-term Exam)
October 11-12	Fall Break
(October 28)	(Second Mid-term Exam)
November 05	Last Day to Drop a Course
(November 23)	(Third Mid-term Exam)
November 25	Thanksgiving Holiday
December 02	Last Day of Instruction for this class
(December 08)	(Final Exam)

Schedule:

Lecture	Date	Topic	Comments
1	08.24	Discrete-Time Signals and Signal Operations	
2	08.26		Assignmt #1 (due 09.02)
3	08.31		
4	09.02		Assignmt #2 (due 09.09)
5	09.07	Time-Domain Analysis of Discrete-Time Signals	
6	09.09		Assignmt #3 (due 09.16)
7	09.14		
8	09.16		Assignmt #4 (due 09.23)
9	09.21	Discrete-Time Convolution	
10	09.23	**First Mid-term exam**	Assignmt #5 (due 09.30)
11	09.28		
12	09.30		Assignmt #6 (due 10.07)
13	10.05	The *z*-Transform	
14	10.07		Assignmt #7 (due 10.19)
	10.12	**Fall Break – No Class**	
15	10.14		
16	10.19	Transfer Functions and Partial Fraction Expansions	Assignmt #8 (due 10.26)
17	10.21		
18	10.26	z-transform of Difference Equations	Assignmt #9 (due 11.02)
19	10.28	**Second Mid-term exam**	
20	11.02		Assignmt #10 (due 11.09)
21	11.04	System Realization	
22	11.09		Assignmt #11 (due 11.16)
23	11.11	Frequency Response	
24	11.16		Assignmt #12 (due 11.23)
25	11.18	Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)	
26	11.23	**Third Mid-term exam**	
	11.25	**Thanksgiving Holiday**	
27	11.30	Sampling and DFT	
28	12.02	Course review	
Final	**12.08**	**3:00-6:00 PM**	