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University of New Mexico, Albuquerque  
Department of Electrical & Computer Engineering  
**ECE-439, Section 003**  
Introduction to Digital Signal Processing  
Fall Semester 2015, 3 Credit Hours

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**COURSE INFORMATION:**

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| Course Instructor | Prof. Balu Santhanam  |
| Office Location   | Room 326A, ECE Bldg.  |
| Contact Info      | Email: <a href="mailto:bsanthan@unm.edu">bsanthan@unm.edu</a><br>Tel: (505) 277-1611 , Fax: (505) 277-1439                            |
| Prerequisite      | ECE-314, ECE-340, knowledge of MATLAB   |
| Location          | ECE-310   |
| Lectures          | TR: 11:00 - 12:15 PM  |
| Textbook          | A. V. Oppenheim and R. W. Schaffer, "Discrete-Time Signal Processing"<br>Third edition, Prentice Hall Inc., Upper Saddle River, 1999. |
| Office Hours      | TBA   |

**GRADING SCHEME:**

Problem Sets/Computer Projects : 40%  
Midterm : 30%  
Final Exam : TBA : 30%

**REFERENCES:**

- J. H. McClellan, R. W. Schaffer, et al., "Computer Based Exercises for Signal Processing Using MATLAB 5.0," Prentice Hall Inc., Upper Saddle River, New Jersey, 1998 (very highly recommended).
- A. V. Oppenheim, A. S. Wilsky and S. H. Nawab, "Signals and Systems," Second Edition, Prentice Hall Inc., Upper Saddle River, New Jersey, 1997.
- Monson Hayes, "Schaums Outline of Digital Signal Processing," McGraw-Hill Companies, 1999.

# COURSE OUTLINE

This course is intended to be a senior level, elective, undergraduate class that provides students with an introduction to fundamental concepts in digital signal processing such as Z-transforms, digital FIR and filter design or spectrum analysis, and an awareness of hardware and software issues in DSP systems.

1. **Z Transform Analysis:** Bilateral Z transforms, region of convergence, left-sided and right-sided sequences, inverse Z transforms, residue theorem.
2. **Sampling and Quantization** Nyquist sampling theorem, upsampling and down-sampling operations, multirate systems, sampling rate change. two-channel filterbank design, uniform quantization model.
3. **LTI Systems and Classification:** stability, causality, magnitude, phase, and group delay response, minimum-phase systems, maximum-phase, all-pass, and linear-phase systems.
4. **Discrete Time Fourier Analysis:** Discrete Fourier series, DTFT, discrete Fourier transform, spectral and power spectrum analysis using the DFT.
5. **Digital Filter Design:** FIR filter design using spectral windows, FIR least-squares filter design, Parks-McClellan algorithm, IIR filter design using impulse invariance or bilinear transformation.

## Additional Information

### Course Webpage

The webpage for the course is located at [www.ece.unm.edu/faculty/bsanthan](http://www.ece.unm.edu/faculty/bsanthan) under ECE-439. Information regarding homework, homework solutions, MATLAB assignments, MATLAB resources, problem sessions etc, will be posted here so please check there often.

### Library and Computer Resources

There will be a folder for ECE-439 at the *centennial science and engineering library* (CSEL) reserve desk. I will also be putting some of the reference material on reserve so that they can be checked out for a limited period of 2 hours. In regards to the computing resources, you should obtain a ECE computer account if you do not already have one. There is an online application form that you need to fill in and submit once you are in the ECE network this will give you access to the ECE Unix and Windows machines that have MATLAB x.x loaded on them. These will come in handy during the MATLAB assignments.

### Exams and Tests

The midterm exam and the final exam for the course will be take-home type exams. You will be given 24 hours to complete the exam. These exams are open book open notes mode exams. For example, if the final exam is on May 11, Thursday, then the take-home exam will be posted on May 10, Wed and will be due back the next day and the end of class time. Please note that **I do not entertain students taking the exam out of order, i.e., neither before or after the exam date** unless it is really extraneous circumstances (health reasons).

## Policies and Assumptions

### Homework and Office Hours

Homework assignments are meant to strengthen your conceptual understanding in the course. They are not intended to be a masochistic ritual. I also recommend that you use my office hours properly and judiciously. If you have not had related material before, this material takes a while to sink in. This is not a “easy” course by any definition and if you have not had exposure to these concepts before then I suggest you do extra problems from the references to strengthen your concepts.

### Attendance Policy

It is assumed that the students are aware of and understand the university attendance policy. In any case if you do not attend class, honestly I don't care, because you are assumed to be adults and it is your money going down the drain.

### Make-up Exam Policy

I do not give make-up exams. If you need to take the exam ahead of time then it is **your responsibility** to arrange a alternative date/time with me and this will be only under extraneous circumstances.

### Exam Regrade Policy

Questions regarding grading in the midterms and the final exam need to be addressed within 1 day of the return of the graded exams. Note further that partial credit assignment remains at the discretion of the instructor and is not subject of debate.

### Cheating and Academic Honesty

It is also assumed that you are familiar with the university academic honesty policy. Needless to say that academic dishonesty will be dealt with seriously. Specifically on take-home exams students are not allowed to consult with each other and their work is expected to be their own effort.

### Prerequisites

I am assuming that you are familiar with the computing software, MATLAB. If you need some review or introduction I can direct you to reference material. I will also go through the review material from ECE-314 and ECE-340 in a very brief fashion. So if you feel that your knowledge of this material is inadequate then you should probably register for the undergraduate courses instead. Problem Set # 0 has been posted on the course webpage and is intended to be a guide to what is expected in terms of ECE-314, ECE-340 concepts. I also have some notes from the ECE-314 course if you need a quick review of the material. Needless to say that it is the **responsibility of the student** to make sure that they have the prerequisite knowledge needed for the course and not the instructors.