

**EE589 Digital Speech Processing (3 credits)**  
**Spring 2008**  
**Klipsch School of Electrical and Computer Engineering**  
**College of Engineering**  
**New Mexico State University**

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**Instructor and Class Information**

Instructor: Dr. Phillip De Leon  
Goddard Annex 160G; (575) 646-DSP1 (3771); pdeleon @ nmsu . edu  
Lecture: Tu, Th 1:10 – 2:25pm, T&B 307  
Office Hours: Tu, 9:00 – 10:00am; W, 3:00 – 4:00pm; and by *prior* appointment

**Course Description from the Graduate Course Catalog**

Speech signal analysis, coding, enhancement, recognition, and synthesis; introduction to linguistics and the human auditory and production systems.

**Prerequisite**

EE395 Introduction to Digital Signal Processing, EE545 Digital Signal Processing, or equivalent.

**Textbook and Other Required Materials**

Required: *Discrete-Time Speech Signal Processing* by Thomas F. Quatieri (ISBN 0-1324-2942-X)

Required: *DSP Software Toolkit* by Phillip L. De Leon (available at Kinko's Copies, Univ. Ave.) Note that this is the same workbook used in EE545 and does not need to be re-purchased.

Optional Reference: *Speech Communications* by Douglas O'Shaughnessy (ISBN 0-7803-3449-3)

**Laboratory Resources**

The DSP teaching laboratory is located in T&B 206 and equipped with PCs and MATLAB. The Advanced Speech and Audio Processing (ASAP) laboratory is located in Goddard Annex 136. Studio-quality audio recording and editing equipment will be made available to students enrolled in this class.

**Online Resources**

EE589 Web Page  
<http://www.ece.nmsu.edu/~pdeleon/Teaching/EE589/>

Course announcements will be emailed via WebCT. WebCT email can be forwarded to an alternate email address.

Student grades will be posted on WebCT. For more information see

<http://salsa.nmsu.edu>

**Course Objectives**

The objective of this course is to gain an understanding of digital speech processing:

- Production and Classification of Speech Sounds
- Acoustics of Speech Production
- Hearing
- Speech Analysis/Synthesis
- Speech Coding, Enhancement, and Modification
- Speaker Recognition

This objective is achieved through a graduate-level treatment of digital speech processing including both theoretical and experimental work.

**Contribution of EE589 to Meeting the Professional Component**

*Digital Speech Processing* is an elective course for specialization in Communications and Digital Signal Processing. Students in EE589 will apply techniques learned in class through problem solving, software development, and in-class discussions. Such a treatment will greatly assist students in understanding research articles in journals such as the *IEEE Transactions on Speech and Audio Processing* and also to conduct independent research. Class provides 3 credits of engineering science credit.

**Relationship of the Course to Program Objectives**

*Digital Speech Processing* provides a foundation for advanced level study in Communications and Digital Signal Processing. This will allow students to further explore their graduate specialty and perform independent research.

**Equal Employment Opportunity / Americans with Disabilities Act (EEO/ADA)**

Feel free to call Jerry Nevarez, Director of Institutional Equity, at 575-646-3635 with any questions you may have about NMSU's Non-Discrimination Policy and complaints of discrimination, including sexual harassment.

Feel free to call Michael Armendariz, Coordinator of Services for Students with Disabilities, at 575-646-6840 with any questions you may have on student issues related to the Americans with Disabilities Act (ADA) and/or Section 504 of the Rehabilitation Act of 1973. All medical information will be treated confidentially.

**Prepared**

Phillip De Leon, 16 January 2008.

**Grading**

*Homework* – There will be regular homework assignments composed of textbook and software problems. The average of the homeworks is worth 20% of the final grade. It is expected textbook problems will be solved in cooperation with your peers and/or Prof. De Leon; software-based problems including the development of code are to be *individually* solved. Late homework is not accepted except in the case of an absence due to a medical or other very serious reason.

*Projects* – There will be two in-depth, individual projects requiring development of MATLAB software for speech processing. Project #1 is anticipated to be due Mar. 20 and Project #2 is anticipated to be due Apr. 24. Each project is worth 20% of the final grade.

*Exams* – There will be two in-class exams during the semester. Exam #1 is scheduled for Thursday, Feb 14. The final examination is scheduled for Tuesday, May 6 from 1:00-3:00pm. Each exam is worth 20% of the final grade.

Note: No early projects or exams will be given. No makeup projects or exams will be given unless a *very serious* situation arose which prevented submitting the project or taking the exam as scheduled.

*Final Grades* – Final grades will be assigned as follows (we reserve the right to lower the grade ranges for particular letter grades but will never raise the grade ranges)

A+		C+	79 – 76
A	100 – 95	C	75 – 73
A-	94 – 90	C-	72 – 70
B+	89 – 86	D+	69 – 66
B	85 – 83	D	65 – 63
B-	82 – 80	D-	62 – 60

The NMSU Student Code of Conduct can be found at <http://www.nmsu.edu/~vpsa/SCOC/scoc.pdf>  
Any act of academic dishonest, i.e. cheating on exam, copying a homework or laboratory assignment, etc... may result in an automatic F in the course.

**Policies**

Disputes regarding homework, laboratory, or exam grades must be submitted in writing to Prof. De Leon for review within 7 days after graded work has been returned or posted.

**Topics Covered / Class Schedule**

The topics covered and class schedule are described in the Course Outline section of this syllabus.

## EE589 Spring 2008 Course Schedule

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**Week 1 January 13, 2008**

Chapter 1, 2: Introduction, DSP Review

**Week 2 January 20, 2008**

*Jan. 21 MLK Day (no class)*

Chapter 3: Production and Classification of Speech Sounds

**Week 3 January 27, 2008**

Chapter 4: Acoustics of Speech Production

**Week 4 February 3, 2008**

Chapter 5: Analysis and Synthesis of Pole-Zero Speech Models (Linear Prediction Analysis)

**Week 5 February 10, 2008**

*Feb. 14, Exam #1 (Ch. 1 – 5)*

Chapter 5: Analysis and Synthesis of Pole-Zero Speech Models (Linear Prediction Analysis)

**Week 6 February 17, 2008**

Chapter 12: Speech Coding

**Week 7 February 24, 2008**

Chapter 12: Speech Coding

**Week 8 March 2, 2008**

Chapter 12: Speech Coding

**Week 9 March 9, 2008**

*Project #1 Speech Coding*

Hearing (Chapters 4 and 5 O'Shaughnessy)

**Week 10 March 16, 2008**

Chapter 7: Short-Time Fourier Transform Analysis and Synthesis

**Week 11 March 23, 2008**

*Spring Break! (no classes)*

**Week 12 March 30, 2008**

Chapter 14: Speaker Recognition

**Week 13 April 6, 2008**

Chapter 14: Speaker Recognition

**Week 14 April 13, 2008**

Chapter 13: Speech Enhancement

**Week 15 April 20, 2008**

*Project #2 Speaker Recognition*

Chapter 13: Speech Enhancement

**Week 16 April 27, 2008**

Chapter 13: Speech Enhancement

**Week 17 May 4, 2008**

*May 6, 1:00pm – 3:00pm Final Exam*

Ch. 12, 13, 14