

# ROWAN UNIVERSITY CURRICULUM PROPOSAL

0909-553 (2)

PROPOSAL TITLE: DIGITAL SPEECH PROCESSING

CHECK APPROPRIATE:  UNDERGRADUATE  GRADUATE  SEMESTER HOURS

SPONSOR(S): RAVEE P. RAMACHANDRAN  
JOHN L. SCHMALZEL

DEPARTMENT/TELEPHONE # ELECTRICAL ENGINEERING / 4643

CHECK ONE:  COURSE  MINOR PROGRAM  CONCENTRATION  SPECIALIZATION  
 ACHIEVEMENT CERTIFICATE  CERTIFICATION PROGRAM  MAJOR PROGRAM

<p style="text-align: center;">Step #1 (Department)</p> <p><u>22 Oct 97</u> Approved (Date) <input type="checkbox"/> Not Approved (Date)</p> <p style="text-align: center;"><u>[Signature]</u> Dept. Curriculum Chr.</p> <p style="text-align: center;"><u>22 Oct 97</u> Reviewed (Date)</p> <p style="text-align: center;"><u>[Signature]</u> Dept. Chr.</p>	<p style="text-align: center;">Step #2 (Receipt)</p> <p style="text-align: center;">SCC# <u>97-98-177</u></p> <p style="text-align: center;"><u>10/24/98</u> Date Received Senate</p> <p style="text-align: center;">_____ Senate Curriculum Chr.</p>	<p style="text-align: center;">Step #3 (School)</p> <p style="text-align: right;">Reviewed Date: <u>22 Oct 97</u></p> <p><input checked="" type="checkbox"/> Recommend to Approved <input type="checkbox"/> Recommend NOT to Approve</p> <p>Forward for Open Hearing: <input checked="" type="checkbox"/> WITHOUT Reservations <input type="checkbox"/> WITH Reservations:</p> <p>Comments:</p> <p style="text-align: center;"><u>Robert P. Herkeith</u> School Committee Chr.</p>
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Step #4 (Academic Dean):  Recommended  NOT Recommended  Conditionally Recommended (See Comments)

Comments:

Dean Signature/Date: [Signature] 10/29/97

Step #5 (Senate Curriculum Committee): Open Hearing Date: \_\_\_\_\_ Approved by Curriculum Committee Date 4-7-98

Returned to Sponsor(s) for the following reason: consult w/ Computer Science

Step #6 (Senate) Date announced/voted on at Senate 12-16-97 If voted on:  Approved  NOT Approved

Date forwarded to Executive Vice President/Provost \_\_\_\_\_

Senate Curriculum Committee chair Signature/Date: [Signature] 11/2/98

Step #7 (Executive Vice President/Provost): Date Received \_\_\_\_\_

\_\_\_ Approved

\_\_\_ NOT Approved If no, reasons are as follows:

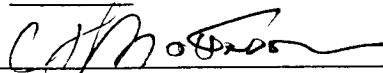
Student Credit Hours \_\_\_\_\_

Faculty Load Hours \_\_\_\_\_

Equalized Credit Hours \_\_\_\_\_

Official Copy & Approval Sheet Filed (Date) \_\_\_\_\_

Executive Vice President/Provost Signature \_\_\_\_\_



Registrar

Date Approved Course Description Received 5-12-98

Regis Taxonomy and Course Number Assigned 0100-100

Date/Signature of Registrar \_\_\_\_\_



Notification Forward:

Senate Curriculum Committee Chairperson

\_\_\_ Department Chairpersons

\_\_\_ Academic Dean(s)

\_\_\_ Registrar

\_\_\_ Sponsor(s)

## Course Proposal

### 1. Details:

a) Course Title:	Digital Speech Processing
b) Sponsor:	Dr. Ravi P. Ramachandran, Dr. John L. Schmalzel and Electrical Engineering Curriculum Committee
c) Credit Hours:	3 credit hours
d) Course Level:	Graduate
e) Curricular Effect:	Second level course for Masters students
f) Prerequisites:	Background in digital signal processing
g) Suggested Time/ Scale of Implementation	Spring 1998 One section
h) Resources	Faculty will be hired and laboratory equipment obtained consistent with Engineering School multi-year budget. Library acquisitions will be required.

### 2. Rationale:

The proposed course is a revision to part of the Engineering Curriculum Proposal approved by the College Senate in December, 1994. The proposed course is consistent with the establishment of the School of Engineering approved by the Board of Trustees in February, 1995.

The impact of digital speech technology in the world market has been rather awesome. Speech communication has applications in wireless telecommunications. Speech synthesis can be used to configure talking computers that can aid the handicapped. Speech recognition provides for automated telephone service. Speaker recognition allows for a speaker to be recognized by his/her voice and has great implications in security particularly over the internet. For the student to gain a basic knowledge of different aspects of speech processing enables a wide access to many exciting opportunities in industry. Also, speech is integrated with audio and video for multimedia communication and services which has a market of at least 100 billion dollars. There is great scope to be part of the beautiful world of speech processing.

### 3. Essence of the Course:

#### a) Objectives:

The proposed course has a number of objectives:

- (i) Provide an overview of the different areas of digital speech processing and stress real-life engineering examples.
- (ii) Develop the ability to mathematically understand and simulate digital speech processing operations and overall systems using C and MATLAB.

**b) Topical Outline:**

- Speech production and vocal tract modeling: characteristics of sounds; throat and ear anatomy; lossless tube models.
- Linear prediction analysis: autocorrelation method; lattice methods; equivalent parameterizations of the linear predictor coefficients;
- Scalar and vector quantization: Lloyd-Max and Linde-Buzo-Gray design methods; use in quantizing linear prediction parameters.
- Speech Coding: PCM; ADPCM; pitch prediction; analysis-by-synthesis paradigm; CELP coders.
- Speech Recognition: system perspective; hidden markov models, robustness issues.
- Speaker Recognition: system perspective; use of vector quantizer classifiers; robustness issues.
- Speech Synthesis: system perspective; intonation issues.

**c) Evaluation and Grading Procedures:**

Student grades will be based on projects, examinations, homework, laboratory reports and written and oral technical communication.

**d) Course Evaluation:**

The proposed course will be evaluated based on student evaluations and critical review by engineering faculty.

**e) Texts:**

L. R. Rabiner and R. W. Schafer, *Digital Processing of Speech Signals*. Prentice-Hall: New Jersey, 1978.

J. R. Deller, J. G. Proakis and J. H. L. Hansen, *Discrete-Time Processing of Speech Signals*. Macmillan Publishing: New York, 1993.

L. R. Rabiner and B.-H. Juang, *Fundamentals of Speech Recognition*. Prentice-Hall: New Jersey, 1993.

R. P. Ramachandran and R. J. Mammone (editors), *Modern Methods of Speech Processing*. Kluwer Academic Publishers: Boston, 1995.

**4. Results of Consultations:**

**a) Consulted Departments:** None

**b) Consultants and Consultant Statements:** N/A

**c) Written Consultations:** N/A

**5. Additional Supporting Information:** N/A

## **6. Catalog Description:**

This graduate course covers the fundamentals of digital speech signals and processing and simultaneously stresses real-life engineering aspects from a systems perspective. An overview of the different branches of speech processing are covered, namely, speech production, vocal tract modeling, speech coding, speech recognition, speaker recognition and speech synthesis. The building blocks of such applications, namely, linear predictive analysis and quantization (scalar and vector) are taught.

**Prerequisite:** Background in digital signal processing