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OFFICE OF THE SENATE COUNCIL

APPLICATION FOR NEW COURSE

1. Submitted by College of Engineering Date 9-15-2006

   Department/Division offering course Electrical and Computer Engineering

2. Proposed designation and Bulletin description of this course
   EE513 Audio Signals and Systems

   a. Prefix and Number EE513 b. Title* Audio Signals and Systems

   *NOTE: If the title is longer than 24 characters (including spaces), write
   A sensible title (not exceeding 24 characters) for use on transcripts Audio Signals & Systems

   c. Lecture/Discussion hours per week 2 d. Laboratory hours per week

   e. Studio hours per week 1 f. Credits 3

   g. Course description

   An introduction to digital signal processing and classification methods for audio signals. Topics include signal analysis and system design using correlation functions, power spectra, difference equations, and transfer functions; implementations of filters, classifiers, and audio effects; characteristics and modeling of common audio signals such as speech, music, and noise.

   h. Prerequisites (if any)

   EE422G

   Engineering Standing

   i. May be repeated to a maximum of _____ (if applicable)

4. To be cross-listed as

   _____ (Prefix and Number) _____ (Signature, Chairman, cross-listing department)

5. Effective Date Fall 2007 (semester and year)

6. Course to be offered X Fall ☐ Spring ☐ Summer

7. Will the course be offered each year? X Yes ☐ No
   (Explain if not annually)

8. Why is this course needed?

Student demand. The course was taught as an special topic courses, which was originally requested by a group of students interested in audio signals and system (Average enrollments in pervious special topics course was about 11 students).

Knowledge and background needed in current research programs. Significant research activitiy is underway requiring the ability to understand, characerize, and design systems for filtering and classifying signals. Current and past funded research projects have been hindered by students lacking proper backgrounds resulting in inefficient time use in the research laboratories. Recent research in the Electrical and Computer Engineering Departmetmt and the Center for Visualization and Virtual Environments invovles the development and analysis of systems for advanced human-computer interfaces, multimedia processing, and classification systems with biometric data. This course would serve all these and related projects, thereby enhancing the quality of research and expanding the capacity to do more.

Knowledge and background needed in growing industires. In spite of the many years of development in audio systems, demand continues for engineers with this expertise because of the ubiquous presence of speech and audio signals at human gatherings/interactions. Trends to utilize audio in computer interfaces, low bandwidth channels/networks, and low power portable devices to capture, play, and organize information. This course provides students with the background required to compete for jobs in this industry (signal processing in general and audio systems in specific).

9. a. By whom will the course be taught? K.Donohue, or S. Cheung, or L.Hassebrook, or D. Lau

b. Are facilities for teaching the course now available? X Yes ☐ No
If not, what plans have been made for providing them?

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10. What enrollment may be reasonably anticipated? 12-18

11. Will this course serve students in the Department primarily? X Yes ☐ No

Will it be of service to a significant number of students outside the Department? ☐ Yes X No
If so, explain.

Will the course serve as a University Studies Program course? ☐ Yes X No

If yes, under what Area?

12. Check the category most applicable to this course

☐ traditional; offered in corresponding departments elsewhere;

X relatively new, now being widely established (at least at the undergraduate level)

☐ not yet to be found in many (or any) other universities

13. Is this course applicable to the requirements for at least one degree or certificate at the University of Kentucky? X Yes ☐ No

14. Is this course part of a proposed new program: ☐ Yes X No
If yes, which?

15. Will adding this course change the degree requirements in one or more programs? ☐ Yes X No
If yes, explain the change(s) below (NOTE – If "yes," a program change form must also be submitted.)

16. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.
(see student learning outcomes in attached syllabus)

18. If the course is 400G or 500 level, include syllabi or course statement showing differentiation for undergraduate and graduate students in assignments, grading criteria, and grading scales. X Check here if 400G-500.
(See grading policy in attached syllabus).

19. Within the Department, who should be contacted for further information about the proposed course?

Name Kevin D. Donohue Phone Extension 7-4004

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Signatures of Approval:

23 in favor 0 against 9/8/06 Date of Approval by Department Faculty	Reported by Department Chair
12/14/06 Date of Approval by College Faculty	Reported by College Dean
3/20/07 *Date of Approval by Undergraduate Council	Reported by Undergraduate Council Chair
*Date of Approval by Graduate Council	Reported by Graduate Council Chair
*Date of Approval by Health Care Colleges Council (HCCC)	Reported by HCCC Chair
*Date of Approval by Senate Council	Reported by Senate Council Office
*Date of Approval by University Senate	Reported by Senate Council Office

*If applicable, as provided by the Rules of the University Senate

Rev 7/06

EE599-002 Audio Signals and Systems, Fall Semester 2006

Instructor: Dr. K.D. Donohue **Phone:** 859-257-8042 **Email:** donohue@engr.uky.edu
Office: 467D Anderson Hall **Hours:** Tue. 9-11AM & Wed 2-4PM **URL:** http://www.engr.uky.edu/~donohue/
Background: Students should have engineering standing and have completed EE422 before taking this course.

Expected Student Outcomes:
A student who has successfully completed this course should be able to:
1. Characterize digital audio systems with difference equations and transfer functions.
2. Characterize digital audio signals with correlation functions and power spectra.
3. Design systems for processing audio data for applications such as filtering, audio effects, and signal classification.
4. Know the fundamental principles of acoustic energy generation and propagation.
5. Program with mathematics software to implement and evaluate designs.
6. Work as a team to solve multi-component problems.

Text: Speech and Audio Signal Processing (Processing and Perception of Speech and Music), Ben Gold and Nelson Morgan, John Wiley & Sons, 2000.
Class Email List: To receive relevant communications and homework assignments for this class you must register for the list at the following web site: http://lists.engr.uky.edu/mailman/listinfo/ee599-2
Materials: Matlab will be use extensively and is on all university computers. A student edition of Matlab is also available see http://www.mathworks.com/support/product/SV/ for more information.

Grading:	Final Exam (1)	31%
	Quizzes (5)	25%
	Studio Assignments (4)	32%
	Homework (10)	12% for undergraduate students 6% for graduate students
	Paper Review (1)	6% for graduate students (not required for undergraduate students)

Grading scale: For undergraduates 100-90% = A, 90-80% = B, 80-70% =C, 70-60% = D, and 60-0% E.
For graduates 100-90% = A, 90-80% = B, 80-70% =C, 70-0% E.

Final Exam: The final exam will be comprehensive and similar in complexity to in-class quiz problems, homework problems, and subcomponents of the studio assignments. The final exam primarily assesses course outcomes 1 through 4.

Quizzes: Quizzes will be given throughout the semester to test recently acquired skills / knowledge. In-class quizzes will typically involve problems that can be solved without the help of specialized computer software. Take-home quizzes will require the use of specialized software and the solutions are to be completed **independently**. There will likely be 6 quizzes, and the 5 highest quiz scores will be taken to compute the final grade. No makeup quizzes will be given. The quizzes primarily assess course outcomes 1 through 4.

Studio Assignments: Studio assignments involve designing, implementing, and demonstrating a solution to a posed problem with students working in teams (typically 2 to 3). Time will be given in class (location will be in a lab with workstations) to work on the problem with instructor present for interactions. The assignment may extend over several class periods. Some assignments may require a short description of the results (a few paragraphs and figures), but all will require a short demonstration to the class and oral questions from the instructor directed to individual group members. The final grade will have a common component based on the solution and how effectively the group worked together, and an individual component based on responses to questions/contributions. The studio assignments primarily assess all course outcomes.

Homework: Homework primarily involves responding to problems posed in the textbook or in the lecture. Homework assignments focus on the assessment of outcomes 1 through 4. Late homework assignments will not be accepted.

Paper Review: *For graduate students only*, read a research paper (approved first by instructor) on audio signals/systems and write a critical report on it. The report must accurately summarize what the authors claim to show, describe their methods, site other related works that support/contradict the findings, and critically assess the degree to which they established their claims. The paper review primarily assesses outcomes 1 through 4.

Unethical behavior (cheating): Unethical behavior includes using/reporting false data, copying another student's work, and claiming a piece of someone else's work as your own. Any of these infractions can result in an E for the course and the university may pursue further disciplinary actions (see http://www.uky.edu/StudentAffairs/Code/).

Tentative Course Schedule EE599				
	Lecture Dates	**Text Section**	**Problems**	**Lecture Topics**
1	8-23,25,28,30	Chapters 1-5	Text: 2.4,3.1,3.5,5.1,5.4 class: (Matlab)	History/Introduction to Matlab's sound functions
2	9-1,6,8	Chapter 6	Text: 6.1,3,4,7,8,9,10,11,12, 13 Class: (Matlab)	DSP general models (Z-transforms and difference equations)
3	9-11,13,15	Chapter 6 (Notes)	Studio Assignment 1: Digital oscillator for a complex tone	Digital oscillators, Complex tones **(Quiz 1)**
4	9-18,20,22	Chapter 7.1-7.5	Text: 7.1,2 Class: (Matlab)	Digital filters **(graduate students: select review paper)**
5	9-25,27,29	Chapter 7.6-7.8 (Notes)	Text: 7.4, 6, 7, 10 Class: (special problems)	DFTs, Power spectra, Spectrograms, and correlation functions (Analysis and design of audio signals and systems), **(Quiz2)**
6	10-2,4	Chapter 7 (notes)	Studio Assignment 2: Characterize noise (room,/quantization) distortion (sampling/amplifier)	Noise, distortion, and sampling
7	10-9,11,13	Chapter 7 (notes)	Studio Assignment 3: Filter design for signal enhancement	Filter design, Optimal filtering **(Quiz 3)**
8	10-16,18,20	Chapter 8	8.1,2,3,4,5 Class: (special problems)	Feature vectors, Pattern classification, Neural networks **(Quiz 4)**
9	10-23,25,27	Chapter 9 9.1-9.7	9.1,2,3 Class: (special problems)	Classifiers: Maximum likelihood, Bayes, Linear discriminants
10	10-20,11-1,3	Chapter 10	10.1,4,5,7,8,10,12,13	Acoustic energy generation and propagation
11	11-6,8,10	Chapter 11	11.2,3,4,5,6,7	Speech (modeling sounds from human voice mechanics) **(Quiz 5)**
12	11-13,15,17		Studio Assignment 4: Design, build, and test a word classifier	
13	11-20,22	Chapter 12.1-12.6	12.1,2,4,5	Music (tonal and percussive sounds, timbre, harmonic analysis, stringed instruments)
14	11-27,29,12-1	Chapter 12.7-12.8	12.6,7,8,9	Music (percussive and wind instruments) **(Quiz 6)** **(graduate students: Hand in paper review)**
15	12-4,6,8	Review		
16	12-11:15		Final Exam	