COURSE OUTLINE
ELEC9724: AUDIO AND ELECTROACOUSTICS
SESSION 2, 2009

1.1 Subject Objectives
The course bridges the gap between the physics of sound (Acoustics), the perception of sound (psychoacoustics) and the signal processing of audio signals in electronics and software. While various existing courses offer some elements of all of the above, there is no convergence of the theoretical concepts of what is essentially a multi-disciplinary field. At the end of the course students will have a physical foundation and have learnt the fundamental theory behind the processing of audio signals. Such knowledge is essential in understanding the processing of speech and music signals in both hardware (various audio equipment including microphones and amplifiers) and software (Digital Signal Processing). Topics covered will include: Acoustics, 1-D Digital Processing Concepts, Psychoacoustics, Microphones, Amplifiers, Digital Speech & Music systems, and Reverberation.

1.2 Topics:
- Foundations: Fundamental laws of physics,
- Vector Calculus, Tensors, Potential theory, Gauss' & Green's Theorem
- Wave propagation in different co-ordinate Systems: Rectangular, Cylindrical, Spherical, Spheroidal
- Physical Modeling – Analogy to electrical circuits.
- Acoustics of Speech & Music.
- Psychoacoustics & Physiology of Hearing
- Transducers: Microphones & Loudspeakers.
- Audio Coding

1.3 Subject Pre-Requisites:
Signal Processing 1 (Third Year), or equivalent

1.4 Instructor
- Dr. D. Sen
  Room EE306
  E-mail: dsen@ee.unsw.edu.au
- Consultation hours: best time is right after tutorials and lectures.

1.5 Lectures
- Tuesday, 6pm to 9pm; EE-222

1.6 Assessment
- 25% for an in-class quiz (compulsory - exemption granted only with a medical certificate)
- 25% for project (compulsory - exemption granted only with a medical certificate).
- 50% final exam
Recommended Texts

- Lecture materials and associated material will be made available over the internet.

- Recommended Reading:

1.7 Other materials

- Supplementary handouts, including tutorial problems, assignments, etc will accompany the lectures.

1.8 Academic honesty and plagiarism

What is Plagiarism?

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<tr>
<th>Plagiarism is the presentation of the thoughts or work of another as one’s own.* Examples include:</th>
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<tbody>
<tr>
<td>➢ direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person’s assignment without appropriate acknowledgement;</td>
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<td>➢ paraphrasing another person’s work with very minor changes keeping the meaning, form and/or progression of ideas of the original;</td>
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<td>➢ piecing together sections of the work of others into a new whole;</td>
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<td>➢ presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and</td>
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<td>➢ claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†</td>
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For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.
The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle

† Adapted with kind permission from the University of Melbourne.
1.9 **Graduate Attributes**

The graduate attributes contributed by this course includes:

- The skills involved in scholarly enquiry
- The capacity for analytical and critical thinking and for creative problem-solving
- The ability to engage in independent and reflective learning
- Information literacy - the skills to appropriately locate, evaluate and use relevant information
- The capacity for enterprise, initiative and creativity
- The skills required for collaborative and multidisciplinary work

1.10 **Weekly Program**

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<thead>
<tr>
<th>Week (Date)</th>
<th>Weekly Topic(s)</th>
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<tbody>
<tr>
<td>1 20/7</td>
<td>Foundations: Laws of physics, Speed of Sound in fluids</td>
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<tr>
<td>2 27/7</td>
<td>Foundations: Vector Calculus, Tensors, Gauss'/Greens Law, Potential Theory</td>
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<tr>
<td>3 3/8</td>
<td>Co-ordinate systems</td>
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<tr>
<td>4 10/8</td>
<td>Simple Harmonic Motion, Qualitative Characteristics of Sound, Level/Power, Diffraction, Reflection</td>
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<tr>
<td>5 17/8</td>
<td>Physiology of Hearing &amp; Psychoacoustics</td>
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<td>6 24/9</td>
<td>Digital Signal Processing of Audio &amp; Audio Coding</td>
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<td>- 7/9</td>
<td>Mid Session Break</td>
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<tr>
<td>7 14/9</td>
<td>In-class quiz #1: Linear prediction (2\textsuperscript{nd} Hour)</td>
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<tr>
<td>8 21/9</td>
<td>DSP &amp; Audio Coding (continued)....</td>
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<tr>
<td>9 28/9</td>
<td>Wave propagation fundamentals in various co-ordinate systems</td>
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<tr>
<td>10 5/10</td>
<td>Wave propagation continued...</td>
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<tr>
<td>11 12/10</td>
<td>Surround Sound, 3D Audio, Room Acoustics &amp; Reverberation fundamentals and effects.</td>
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<tr>
<td>12 19/10</td>
<td>Project Demonstration</td>
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**Lectures:** Tuesdays 6-9 pm;