Course: Audio Engineering 1

A theoretical examination of the principals of operation of the essential components of the sound recording and reinforcement chain from acoustic venue, through transduction, electronic manipulation and storage, and the reproduction of the acoustic field in various listening environments. A qualitative approach to the essential engineering concepts will be taken such that only a knowledge of simple trig functions and elementary algebra will be required. The global nature of these concepts will be emphasized wherever appropriate; i.e.

1. Sound is characterized as noiselike, or as periodic. Readings from Helmholtz defining the nature of all pitched sounds through Fourier analysis describes these musical sounds as a particular case of general periodic functions.

2. Feedback control systems, or Servo describes a class of closed loop electromechanical and electronic topologies which allows elements of the audio recording and reproduction chain to be highly accurate and distortion self-correcting. These are the same Automatic Control Systems which are present in many phenomena in Nature; biological, geological, ecological, etc.

3. Digital Audio must be understood in the context of Information Theory beginning with the Uniform Sampling Rate Theorem. The width of the transmission and storage channel determines the accuracy of the audio signal passed. Sampling frequency and bit depth determine the quality of the overall system, and may be chosen to match the capabilities of human hearing. The counterintuitive nature of sampling near the Nyquist frequency will be examined.

This course is designed to give the student a basic theoretical understanding of how the elements of the audio chain function. It is not so much intended to answer the question “how to,” but rather to answer the question “how does it do that?” Knowledge of how each element works internally will allow the student to do her/his own analysis and problem solving based on practical theory. In certain areas, this theoretical approach will be supplemented with practical operational instruction; in Mixing Console operation, for example.

Theory will be supplemented with Critical Listening. We will listen to and analyze in detail many recorded examples from all fields of music. Why are bad recordings bad, and why are the good ones good? This Technical Ear Training component will examine the nature of reproduced sound, acoustics, and distortion. Students will be encouraged to bring in their own work, or favorite music for class analysis and discussion.

Following are the essential topics to be covered:

1. Overview: Edison to Digital
3. Parameters and Measurement of Sound. The dB. What can we really hear?
5. The Physiology of the Ear, and Psychoacoustics. Microphones.
6. The Aesthetics of Listening.
Amplifiers, Operational Amplifiers and Negative Feedback Automatic Control Systems.

The Mixing Console / Preamplifiers.


Interconnect Cables and Levels. Balanced and Unbalanced Configurations. Level Matching in the large or small system.

The Nature of Distortion.

Electronic Digital Recording vs. Analog


Perceptual Coding and Data Compression Systems: MP3 and Dolby AC3.

Masking Criteria, and Lossless Coding Techniques such as Run Length Coding and Entropy Coding. What your Ears are Missing.

Technical Ear Training: Extended listening to examples up to 30 minutes and more each class period. Critique and discussion to be presented by students in class as well. Students will be asked to present examples in class for listening and analysis. Significant criteria such as: noise, distortion, sense of space, foreground/background, compression effects, frequency response and spectral shape, appropriateness of technique for the music recorded will be discussed in detail.

A Final Project will consist of an electroacoustic analysis of a comparison of 2 musical examples. This may be a comparison of 2 different recordings of the same piece, or recordings of different pieces to show appropriateness of contrasting recording techniques. This comparison will now be repeated on a completely different sound reproduction system to demonstrate the effects of the reproduction system itself. There are many different possibilities, and opportunities to point out successes and failures, to offer possible explanations, and to suggest fixes. This will be presented in the form of a detailed paper of a minimum of 5 pages. We will discuss this subject in more detail in class before papers are begun.

Attendance in class is mandatory. A Reader has been developed which contains all of the reading assignments and technical documents for use in class. It is on Reserve in the Music Library, and can be removed for short periods for copying at Kinkos. It is entitled “Audio Engineering I Reader”. The “Audio Engineering Reader Annex” must also be copied. It contains additional technical information and reading assignments. Both of these documents are also available in PDF form on a CDR. Please make your copy as soon as possible after the first class, since reading assignments and technical references in class will begin immediately. Most of the material to be discussed is simply not available in the form of articles or books. Students must be present in class, since this is the only place in which the material will be presented. Exams will be based exclusively on what is discussed in class, and a significant portion of the grade is dependent on presence in class. Since there is a great deal of material to cover, and classes are once a week, you must not miss sessions. This is in seminar format, and all students are encouraged to actively participate. Please do not hesitate to ask questions. Your questions and opinions are valuable. Do not miss the opportunity to ask a question or to contribute an idea. We will be doing a great deal of listening during the semester. Technical Ear Training is best done by making your opinions known in class. We are all students in this endeavor, and can always learn from the observations of our colleagues.
Our subject is vast. If there are any particular topics which you would like to see covered in class, please ask. We will do our best to see that these areas are presented at the appropriate point in the syllabus.

Grading will be based upon:

1. Mid term
2. Final
3. Class Participation
4. Final Written Analysis Project
5. Class Attendance

These five factors will be weighted equally for the final grade.

Learning Outcomes:

1. Students must demonstrate an understanding of each of the technical areas listed above. This understanding will be tested by 2 written exams.
2. Students must demonstrate competence in technical ear training by their analytical work in class as well as in the final written analysis paper.

**Americans with Disabilities Act**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students requiring emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information, go to the following web site.

[http://www.ehs.sunysb.edu/fire/disabilities/asp](http://www.ehs.sunysb.edu/fire/disabilities/asp)