

## Fundamentals of Acoustics and Audio

Understanding sound and acoustics is basic, and a central and critical skill for audio recording and engineering. To master and utilize today's wide array of sophisticated and eclectic recording options and integrate the pieces into a harmonious whole, the recording engineer needs both historical perspective and up to date personal knowledge. The material in this course covers basic acoustics, psychoacoustics, and an overview of audio engineering with an emphasis on practical applications. Topics include the fundamental elements of digital and analog audio; the behavior of audio equipment, such as microphones, amplifiers, and loudspeakers. Upon successful completion of the course, participants should have a foundation for further studies in audio recording technology. Fulfills prerequisite requirements of Certificated Program in Recording Engineering. Elective course in Certificated Program in Film, Television, and Digital Entertainment Media.

Drew Daniels, electroacoustics consultant and professional musician has served twice as chairman of the Audio Engineering Society (AES), Los Angeles section; applications engineer for Tascam, JBL, and Fender; and principal electroacoustics engineer, Disney Imagineering. Mr. Daniels holds numerous patents in the audio field, including the SFX stereo loudspeaker technology licensed to Fender Musical Instruments. His home studio produced and released dozens of CDs in the past few years, including a CD which received Syntrillium Software's best recording award from over 400 submissions. Roger Kellaway Trio on IPO Records, Dave Frishberg Live At The Jazz Bakery on Arbors Records, and Rob Mullins Live At Steamers, release 2005-6.

<b>Instructor: Drew Daniels</b>	<b>Course No. X441.3</b>	<b>Reg. No. R8459</b>	<b>\$515</b>
<b>April 3, 2006</b> — through —	<b>June 26, 2006</b>	<b>7:00 pm—10:00 pm</b>	
<b>4 Units</b>	<b>325 Botany</b>	<b>Mondays</b>	

### Course Objectives:

- To familiarize students with the language and basic concepts of Acoustics and Audio.
- To develop basic skills with acoustical elements and materials.
- To develop basic understanding of the elements of audio and their relationship to audio end product.

### The course will explore:

- Sound, acoustics, sound capture, sound reproduction, and audio equipment for these purposes.
- Acoustic recording through modern disc-based workstation recording—an history.
- The fundamental behavior of sound and light.
- Human hearing and the science of psychoacoustics.
- Using acoustics and avoiding its pitfalls.
- Using microphones.

### Required Items:

- **TEXT:** The USBORNE ILLUSTRATED DICTIONARY OF PHYSICS. Students are encouraged to bring to class, a basic **scientific calculator** with at least a pi ( $\pi$ ) key and a **log** key. (Texas Instruments model TI-25X Solar or equivalent—about \$8 at stationary stores.)
- Students are also encouraged to record lectures for review, and to make careful notes in class.

### Handouts:

All class handouts plus additional information are available online at: <http://www.DrewDaniels.com/UCLA.htm>  
*Please note the URL IS TEXT CASE SENSITIVE.*

### Exams:

Verbal quizzes may be used to help the instructor gauge and adjust the pace of classroom instruction. At week seven, a non-credit midterm exam will be given to help students adjust their pace of study. The last session will include the Final Exam, which will review presented course material.

### Grading:

Grading will be based on attendance, class participation, understanding of material and the final exam. Careful note-taking and/or recording of class sessions is highly recommended. Students are encouraged to form study groups or note-exchange groups so that missed class sessions can be studied independently as needed.

Class participation is a highly desirable activity that will help students bring the presented material into focus and give it meaning and make it the basis of a set of useable professional tools. Students are expected to let the instructor know if class lecture or topics are confusing or abstract, and to ask for clarification and to offer ideas into the discussion of class topics. There are no stupid questions in audio, just as there is no “right” or “wrong” way to make art.

### Non-USA Resident Students:

While jargon and idiomatic language is minimal in this class, much of the material is based on words and language that may be new to some students. The instructor will make every effort to avoid jargon. Please ask for explanations to help clarify lectures whenever necessary.

**COURSE TITLE:*****Fundamentals of Acoustics and Audio*****PRÉCIS:**

Successful use of today's audio equipment often means "creative" use. Simply being able to plug and play is not enough. Audio equipment in modern facilities has grown enormously complex and versatile, offering the user so many choices and options that it is possible to produce much nonsense and waste much time in the course of looking for meaningful results. It is well known that too many choices makes any choice more difficult. Thus it becomes important to know how and why to repeat good results even when they are first achieved by accident.

Some background in the physics describing movement, sound and light is helpful in making creative choices with most of the equipment one is likely to find and use in modern production and post-production settings, as well as sound itself. A knowledge of basic electronics is indispensable for those who need to operate, interface or assemble audio and video equipment.

"Fundamentals of Acoustics and Audio" is intended for people who will operate audio electronic equipment in their job. There is no prerequisite and no technical background is required.

Students will discover electrical signals, magnetism, motion, waves, acoustics, power, hearing and psychoacoustics. The course will include review of signal flow with it's diagrammatic language, and basic equipment techniques with assembly and operation of the basic recording signal chain.

**SYLLABUS:****SESSION 1****April 3, 2006****Class Orientation, Course Description and Overview**

*Session includes printed handouts. A list of recommended books and materials will be discussed. The important link between musical instruments and their underlying physical principles will be discussed as time permits.*

**SESSION 2****April 10, 2006****Basic Acoustics begins.****VIDEO: Harmonic Motion**

*Video program will be screened and discussed. Lecture may include printed handouts and/or demonstrations of common examples of the topics shown. Musical instruments and their sound production will receive the remaining time.*

**SESSION 3****April 17, 2006****VIDEOS: Waves Optics**

*We examine waves. Sound propagation follows wave principles. So does radio and television transmission and light. We will discuss wave propagation, reflection, dispersion, refraction and absorption. These concepts are all central to understanding sound and acoustics, and other principles that can boost creativity in audio production or post-production. Also covered are wave dimensions vs. frequency and the interactions with rooms that result from their size.*

**SESSION 4****April 24, 2006****VIDEO: Resonance**

*Resonance is the engine of musical instruments. Resonance drives the design of musical instruments, and drives microphone and loudspeaker designers to avoid resonance. To make the best use of most audio tools, it is critical to understand resonance. A review and discussion of basic acoustics will also be presented.*

**SESSION 5****May 1, 2006****Acoustics**

*Previous screenings will be available as we discuss acoustics in greater depth. Acoustics is widely regarded as black art in the Audio and Video technical communities, because it involves abstractions not generally examined in engineering schools and because it plagues people who use loudspeakers to judge audio quality for a living. My axiom “every good loudspeaker comes with a room to ruin it” will be discussed in depth. As we will see, acoustics is in fact, understandable and even manageable. We will discuss human hearing and its impact on various other aspects of perception based on the use of loudspeakers in rooms.*

**SESSION 6****May 8, 2006****Hearing and the Ear-brain**

*To understand how we hear and process what we hear, is to understand how to manipulate the recording’s ultimate listener. Insights into hearing can be a powerful tool for the audio producer or engineer.*

**SESSION 7****May 15, 2006****Midterm Exam**

*The midterm exam will give students a status check on their grasp of material presented so that they may adjust their study schedule as needed. Remaining time will be used for a free-form question and answer period. Although the midterm exam session will not count for course credit, it will offer students an opportunity to exchange observations with the instructor.*

**SESSION 8****May 22, 2006****Psychoacoustics**

*The influence of our perception on recorded end product is discussed. The human ear is not a microphone and the extent of it’s influence on musical judgement might surprise you. Also in this session; we learn about typical pitfalls and dirty tricks psychoacoustics can play on a listener, and how to employ psychoacoustics to meet your goal of conveying artistic intent to the listener.*

**SESSION 9****June 5, 2006****The Recording Chain**

*Electrical audio is about a century old. In that time, the advances have come as fast and furious as the developments in most technologies—up to a point. We will examine the changes and growth and the sticking points nature imposes on us all. We examine the parts of the system from microphones to loudspeakers, and why our grandchildren will still be seeing similar devices a century from now.*

**SESSION 10****June 12, 2006****The Recording Studio with a Carrying Handle?**

*Much of the gear in the traditional recording studio has been or is being replaced by personal computers and miniaturization. How far can it go? How economical can it get. Will performance improve or suffer? We discuss how to assemble the gear for a no-compromise studio on a budget.*

**SESSION 11**

**June 19, 2006**

**REVIEW and FINAL EXAM PREPARATION** *This session will feature the class quizzing the instructor. This class session will be review and discussion of the entire quarter's topics.*

**SESSION 12**

**June 26, 2006**

**Final exam.**

*The final exam will consist of questions culled from the entire course. The exam will be printed in advance and done at the class session. The test will contain fill-in, simple computation, multiple-choice and essay questions. Spelling, grammar and punctuation will not be taken into account in grading. The tests will be collected after 2½ hours and graded. Special circumstances requiring a student to make up the test or take it elsewhere must be arranged with the instructor no later than week 11. Grading of the final exam will be done on the basis of a simple percentage of the questions answered over a predetermined minimum number of correct answers.*

*Percentage for grades: A= >90%, B=80%—89%, C=70%—79%, D=60%—69%, Fail= <59%.*

*Overall course grading will be based 20% on attendance, 30% on class participation and individual student comprehension, and 50% on the final exam score.*

To receive later notification of grades you **must** turn in or mail a stamped grade card to the instructor no later than five days after the final exam, sent to:

Drew Daniels  
Fundamentals of Acoustics & Audio, Class X448.59  
UCLA Extension - Room 437  
P.O. Box 24901  
Los Angeles, CA 90099-6137

**Optional reading recommendations:*****FOR AUDIO NOVICES:*****BOOKS:**

- “Acoustic Techniques for Home and Studio,” Everest, F. Alton, Tab Books, Blue Ridge Summit 1973
- “Broadcast Communications Dictionary,” Diamant, Hastings House, New York 1974
- “Building Speaker Enclosures,” David B. Weems, Radio Shack publication, stock# 62-2309
- “Designing, Building & Testing Your Own Speaker System,” David B. Weems, Tab Books #1364  
(this is the same as the Weems book above)
- “Dictionary of Film & Television Terms,” Oakey, Barnes & Noble, New York 1983
- “The CAMEO Dictionary of Creative Audio Terms,” Creative Audio & Music Electronics Organization, 10 Delmar Avenue, Framingham, MA 01701
- “The Complete Handbook of Public Address Sound Systems,” F. Alton Everest, Tab Books #966, Tab Books, Blue Ridge Summit, PA 17214
- “Hi-Fi Loudspeakers and Enclosures,” Abraham B. Cohen, Hayden Book Co., 0721
- “Introduction to Professional Recording Techniques,” Bartlett, Bruce, Howard W. Sams & Co., Indianapolis 1987
- “How to Build Speaker Enclosures,” Alex Badmaieff and Don Davis, Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46268
- “Making Music,” Martin, George, William Morrow & Co., New York 1983
- “Practical Guide for Concert Sound,” Bob Heil, Sound Publishing Co., 156 East 37th Street, New York, NY 10016
- “Questions & Answers About Tape Recording,” Burstein, Herman, Tab Books, Blue Ridge Summit 1974
- “Recording Demo Tapes at Home,” Bartlett, Bruce, Howard W. Sams, Inc., Indianapolis
- “Technique of the Sound Studio,” Nisbett, Alec, Focal/Hastings House, New York 1979
- “Telling the Story,” Josephson, Larry (ed), Kendall Hunt, Dubuque 1983
- “Yamaha Sound Reinforcement Handbook,” Gary Davis and Ralph Jones, Hal Leonard Publishing, 7777 W. Bluemound Road, P.O. Box 13819, Milwaukee, WI 53213

**PAPERS:**

- “The Most Commonly Asked Questions About Building Enclosures,” Drew Daniels, JBL Professional, 8500 Balboa Blvd., Northridge CA, 91329
- “Using the enclosure design flow chart,” Drew Daniels, JBL Professional, 8500 Balboa Blvd., Northridge, CA 91329

**FOR EXPERIENCED AUDIO PRACTITIONERS AND HOBBYISTS:****BOOKS:**

- "The Microphone Book," second edition, John Eargle, Focal Press, ISBN 0-240-51961-2 [www.focalpress.com](http://www.focalpress.com)
- "Acoustic Noise Measurement," Jens Trampe Broch, Bruel & Kjaer Instruments, Inc., 185 Forest Street, Marlborough, MA 01752 (617) 481-7000
- "Acoustics of Music," Bartholomew, Wilmer T., Prentice Hall, New York 1942
- "Audio Craft," Merrick, C. et al, National Federation of Communications, Washington 1982
- "The Audio Cyclopedia," Howard M. Tremaine, 2nd Edition 1969, Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46268
- "Audio Equipment," Green, Michael, DMR Publications 1978
- "Audio Production Techniques for Video," Huber, David M., Howard W. Sams & Co., Indianapolis
- "Audio Systems," Herrick, Clyde N., Reston Publishing Co., Reston 1974
- "Audio in Media," (2nd ed.), Alten, Stanley R., Wadsworth Publishing Co., Belmont, CA 1986
- "Building A Recording Studio," Cooper, Jeff, Synergy Group Inc., Los Angeles 1984
- "Basic Disc Mastering", Boden, Larry, Full Sail Recording Workshop, Orlando 1981
- "Basics of Audio and Visual Systems Design," Wadsworth, Raymond, Howard W. Sams, Inc., Indianapolis
- "Complete Handbook of Magnetic Recording, 3rd ED," Jorgensen, Finn, Tab Books, Blue Ridge Summit 1988
- "Handbook of Multichannel Recording," Everest, F. Alton, Tab Books, Blue Ridge Summit 1975
- "Handbook of Noise Measurement," Arnold P. Peterson and Ervin E. Gross, Jr., General Radio, 300 Baker Avenue, Concord, MA 01742
- "High Performance Loudspeakers," Martin Colloms, a Halstead Press Book, 1978 John Wiley and Sons, New York and Toronto.
- "Magnetic Recording for the 1980's," Government Printing Office, Washington 1982
- "Master Handbook of Acoustics," Everest, F. Alton, Tab Books, Blue Ridge Summit 1981
- "Microphone Handbook," Eargle, John, Elar Publishing, Plainview, NY 1981
- "Microphone Manual, Design & Applications," Huber, David M., Howard W. Sams & Co., Indianapolis 1988
- "Microphones," Clifford, Martin, Tab Books, Blue Ridge Summit 1982
- "Modern Recording Techniques" (3d Ed.), Runstein, R.E. & Huber, D.M., Howard W. Sams, Indianapolis 1988
- "Modern Sound Reproduction," Harry F. Olson, 1972, Van Nostrand Reinhold Co., New York.
- "Music and Physics," Donald and Harvey White, Holt Rhinehart & Winston Publishing, New York
- "Music Physics and Engineering," Harry F. Olson, Dover Publications, 180 Varick Street, New York, NY 10014
- "Musical Sound," Moravcsik, Michael J., Paragon House Publishers, New York 1987
- "Physics of Music," Scientific American, W. H. Freeman, San Francisco 1978
- "Practical Techniques for the Recording Engineer," Keene, Sherman, Sherman Keen 1981

- “Recording Studio Handbook,” Woram, John M., Sagamore Publishing Co., Plainview 1982
- “Sound Recording,” Eargle, John, Van Nostrand Reinhold, New York 1984
- “Sound Recording & Reproduction,” Akin, Glyn, Focal Press 1981
- “Sound Recording Handbook,” Woram, John M., Howard W. Sams, Inc., Indianapolis 1989
- “Sound Recording Practice” (3rd ed.)(Anthology), Borwick, John (ed), Oxford University Press, New York 1987
- “Sound Recording for Motion Pictures,” Fratari, Charles, A. S. Barnes, 1979
- “Sound Tape Recording, TV Tape Recording & Film,” International Telecommunications Union, Geneva 1985
- “Sound with Vision,” Alkin, E. G. M., Crane, Russak & Co., New York 1973
- “Stereo TV: Production of Multidimensional Audio,” Olearczuk, Roman, Howard W. Sams & Co., Indianapolis
- “Sound System Engineering,” Don and Carolyn Davis, Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46268
- “Successful Sound System Operation,” F. Alton Everest, Tab Books #2606, Tab Books, Blue Ridge Summit, PA 17214
- “Troubleshooting & Repair of Audio Equipment,” Lenk, John D., Howard W. Sams & Co., Indianapolis

**PAPERS:**

- “Notes on 70-volt and distributed system presentation,” Drew Daniels, for the National Sound Contractors Association Convention, September 10, 1985, JBL Professional, 8500 Balboa Blvd., Northridge, CA 91329
- “Thiele-Small Nuts and Bolts with Painless Math,” Drew Daniels, presented at the 70th Convention of the Audio Engineering Society, November 1981 AES preprint number 1802(C8).
- “Tape Recorder Measurement Standard,” Electronic Industries Association, Washington 1984

***FOR ENGINEERS:***

**BOOKS:**

- “Acoustical Engineering,” Harry F. Olson, D. Van Nostrand Co., Inc., 250 4th Street, New York 3, NY 1957 (out of print)
- “Acoustical Designing in Architecture,” Vern Knudsen & Cyril Harris, American Institute of Physics for ASA
- “Acoustics,” Leo L. Beranek, Mc Graw-Hill Book Co., New York 1954.
- “Acoustics and Electroacoustics,” Rossi, Mario, McGraw-Hill, New York 1988
- “AM Stereo and TV Stereo,” Prentiss, Stan, Tab Books, Blue Ridge Summit 1975
- “Art of Digital Audio,” Watkinson, John, Focal Press, London, Boston 1988
- “Audio Control Handbook” (6th Ed.), Oringel, Robert S., Butterworth Publishers, Stoneham, MA 1989
- “Audio Electronics Reference Book,” Sinclair, Ian R., Blackwell Scientific Publications, Inc., Cambridge 1989
- “Audio IC Op-Amp Applications,” Jung, Walter G., Howard W. Sams, Inc., Indianapolis
- “Broadcast Radio and Television Handbook,” Noll, Edward M., Howard W. Sams, Indianapolis 1983
- “Broadcast Operator Handbook,” Government Printing Office, Washington 1976
- “Compact Disc Troubleshooting & Repair,” Heller and Bentz, Howard W. Sams, Inc., Indianapolis

- "Compact Disk, A handbook of Theory and Use," Pohlmann, Ken C., kA-R Editions Inc., Madison, WI 1989
- "Digital Audio," Audio Engineering Soc., Audio Engineering Society, New York 1983
- "Digital Audio Engineering" (Anthology), Strawn, John (ed), William Kaufmann, Los Altos 1986
- "Digital Audio Signal Processing," Strawn, John (ed), William Kaufmann, Los Altos 1986
- "Digital Audio Technology," Nakajima H. et al, Tab Books, Blue Ridge Summit 1983
- "Digital Audio and Compact Disc Technology," Baert, Theunissen & Vergult (Ed.), Heinemann Professional Publishers, Oxford 1988
- "Elements of Sound Recording," Frayne, J.G. & Holfe, H., John Wiley & Sons, Ind., New York 1949
- "Elements of Acoustical Engineering," Harry F. Olson, D. Van Nostrand Co., Inc., 250 4th Street, New York 3, NY (1st ed., 1940, 2nd ed., 1947 -- both out of print)
- "Fundamentals of Acoustics," Lawrence E. Kinsler and Austin R. Frey, John Wiley and Sons, New York and Toronto.
- "Handbook of Recording Engineering," Eargle, John, Van Nostrand Reinhold, New York 1986
- "Handbook for Sound Engineers," Ballou, Glen (Ed.), Howard W. Sams & Co., Indianapolis 1987
- "Handbook of Sound System Design," Eargle, John, Elar Publishing Co, Inc., Commack, NY 1989
- "Loudspeakers: Theory Performance, Testing and Design," N.W. McLachlan, Oxford Engineering Science Series, Oxford at The Clarendon Press 1934, Corrected Edition, Dover Publications 1960.
- "Magnetic Recording," Begun, S. J., Rinehart & Co., New York 1954
- "Magnetic Recording," Lowman, Charles E., McGraw-Hill, New York 1972
- "Magnetic Recording," Vol. 1 (Technology), Mee, C & Daniel, E., McGraw Hill, New York 1988
- "Magnetic Recording," Vol. 2 (Computer Data Storage), Mee, C & Daniel, E., McGraw Hill, New York 1988
- "Magnetic Recording," Vol. 3 (Video, Audio Inst. Rec), Mee, C & Daniel, E., McGraw Hill, New York 1988
- "Magnetic Recording Handbook," Camras, Marvin, Van Nostrand Reinhold, New York 1988
- "Magnetic Recording Techniques," Stewart, W. Earl, McGraw-Hill, New York 1958
- "Measuring Microphones," Bruel & Kjaer, Nærum, Denmark 1982
- "Microphones" (Anthology), Audio Engineering Soc., Audio Engineering Society, New York 1979
- "Principles of Digital Audio," Strawn, John (ed), William Kaufmann, Los Altos 1986
- "Principles of Digital Audio" (2nd Ed.), Pohlman, Ken, Howard W. Sams, Indianapolis 1988
- "Science of Musical Sound," Pierce, John R., Scientific American Press, New York 1983
- "Science of Sound," Rossing, Thomas, Addison Wesley, Reading, MA 1982
- "The Theory and Design of Loudspeaker Enclosures," Benson, J.E., Synergetic Audio Concepts, 12370 W. CR 100 N, Norman, IN 47264, (812) 995-8212, fax: 995 2110 1994
- "Time Code Handbook," Hickman, Walter, Datametrics, Wilmington, MA 1982



"Tone, A Study in Musical Acoustics," Levarie, S. & Levy, E., Kent State University Press, Kent, OH 1980

**PAPERS:**

"AWASP: An Acoustic Wave Analysis and Simulation Program," Don B. Keele, Jr., presented at the 60th AES Convention in Los Angeles, May 1978.

"An Application of Bob Smith's Phasing Plug," Fancher M. Murray, presented at the 61st AES Convention in New York, November 1978.

"Automated Loudspeaker Polar Response Measurements Under Microcomputer Control," Don B. Keele Jr., presented at the 65th AES Convention in London, February 1980.

"Direct-Radiator Loudspeaker System Analysis," R.H. Small, Journal of the Audio Engineering Society (JAES), Vol. 20, p. 383, June 1972.

"Disk Recording Volume 1" (Anthology), Audio Engineering Society, New York 1980

"Disk Recording Volume 2" (Anthology), Audio Engineering Society, New York 1981

"Ground Plane Acoustic Measurement of Loudspeaker Systems," Mark R. Gander, presented at the 66th AES Convention in Los Angeles, May 1980.

"Loudspeakers," An anthology of articles on loudspeakers from the pages of the Journal of the Audio Engineering Society, Vol. 1 through Vol. 25 (1953-1977). Available from the Audio Engineering Society, 60 East 42nd Street, New York, NY 10165 Telephone (212) 661-8528

"Loudspeakers in Vented Boxes," A.N. Thiele, Proceedings of the IREE Australia, Vol. 22, p. 487 August 1961; republished in the JAES, vol. 19, p. 382 May 1971 and p. 471 June 1971.

"The Motional Impedance of an Electro-Dynamic Loudspeaker," Fancher M. Murray, presented at the 98th Meeting of the Acoustical Society of America, November 19, 1979.

"Moving-Coil Loudspeaker Topology As An Indicator of Linear Excursion Capability," Mark R. Gander, presented at the 64th AES Convention in New York, November 1979.

"A Personal Calculator Program for Low Frequency Horn Design Using Thiele-Small Driver Parameters," Garry Margolis and John C. Young, presented at the 62nd AES Convention in Brussels, March 1979.

"Personal Calculator Programs for Approximate Vented-Box and Closed-Box Loudspeaker System Design," Garry Margolis and Richard H. Small, presented at the 66th AES Convention in Los Angeles, May 1980.

"Three Dimensional Diaphragm Suspensions for Compression Drivers," Fancher M. Murray and Howard M. Durbin, presented at the 63rd AES Convention in Los Angeles, March 1979.

"Vented-Box Loudspeaker Systems," R.H. Small, Journal of the Audio Engineering Society, Vol. 21,Z p. 363 June 1973, p. 438 July/August 1973, p. 549 September 1973, and p. 635 October 1973.

"Quadraphony" (Anthology), Audio Engineering Society, New York 1975

"Sound Reinforcement" (Anthology), Audio Engineering Society, New York 1978

"Stereophonic Techniques" (Anthology), Audio Engineering Society, New York 1986

**MANUFACTURER'S TECHNICAL NOTES:**

The following are available from **JBL Professional**:

- Volume 1, Number 1** "Performance Parameters of JBL Low-Frequency Systems"  
**Volume 1, Number 2** "70-Volt Distribution Systems Using JBL Industrial Series Loudspeakers"  
**Volume 1, Number 3** "Choosing JBL Low-Frequency Transducers"  
**Volume 1, Number 4** "Constant Directivity Horns"  
**Volume 1, Number 5** "Field Network Modifications for Flat Power Response Applications"  
**Volume 1, Number 6** "JBL High-frequency Directional Data in Isobar Form"  
**Volume 1, Number 7** "In-Line Stacked Arrays of Flat-front Bi-Radial™ Horns"  
**Volume 1, Number 8** "Characteristics of High-Frequency Compression Drivers"  
**Volume 1, Number 9** "Distortion and Power Compression in Low-frequency Transducers"  
**Volume 1, Number 10** "Use Of The 4612OK, 4671OK, And 4660 Systems In Fixed Installation Sound Reinforcement"  
**Volume 1, Number 11** "Controlled Power Response: Its Importance in Sound Reinforcement System Design"  
**Volume 1, Number 12** "Polarity Conventions of JBL Transducers and Systems"  
**Volume 1, Number 13** "JBL Concert Series Complete Sound Systems"  
**Volume 1, Number 14** "Basic Principles for Suspending Loudspeaker Systems"  
**Volume 1, Number 15** "Choosing the Right Studio Monitor for Specific Applications, A Discussion of JBL and UREI Monitor Loudspeakers"  
**Volume 1, Number 16** "Power Ratings of JBL Loudspeakers and JBL/UREI Amplifiers"  
**Volume 1, Number 17** "Measurement and Interpretation of Loudspeaker Polar Data: A Comparison of JBL Constant Coverage Bi-Radial™ Horns and EV HP Large Format Horns"  
**Volume 1, Number 18** "Vented Gap Cooling™ in Low Frequency Transducers"  
**Volume 1, Number 19** "Sub-Bass Systems Using Triple Chamber Bandpass™ (TCB) Technology"  
**Volume 2, Number 1A** "1/3 Octave Equalization and The JBL/UREI 5547A and 5549A"  
**Volume 2, Number 2** "JBL/UREI Power Amplifier Design Philosophy"  
**Volume 2, Number 3** "Applications for the JBL/UREI 7922 Digital Audio Delay"  
**Instruction Manual:** "Motion Picture Loudspeaker Systems: A Guide to Proper Selection And Installation"  
**Marketing White Paper:** "The Relationship Between the Sound Contractor and Religious Organizations"  
 "Cinema System Design Manual"  
 "Speaker Power Requirements, Answers To Some Often Asked Questions"  
 "JBL Sound System Design Reference Manual" (\$15) or free by modem at 1-209-787-2955

**AUDIO ON THE INTERNET:**

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|---|---|
| <a href="http://asa.aip.org/">http://asa.aip.org/</a>   | <b>Acoustical Society of America</b>                    |
| <a href="http://www.apogeedigital.com/">http://www.apogeedigital.com/</a>                                       | <b>Apogee Electronics</b>                               |
| <a href="http://www.aes.org/">http://www.aes.org/</a>   | <b>Audio Engineering Society, Inc.</b>                  |
| <a href="http://www.aes.org/sections/la/home.htm">http://www.aes.org/sections/la/home.htm</a>                   | <b>Audio Engineering Society Los Angeles Section</b>    |
| <a href="http://www.bk.dk/1200.htm">http://www.bk.dk/1200.htm</a>   | <b>Brüel &amp; Kjær Sound &amp; Vibration</b>           |
| <a href="http://soli.inav.net/~jebraun/mikes.htm">http://soli.inav.net/~jebraun/mikes.htm</a>                   | <b>Classic Microphones</b>                              |
| <a href="http://www.event1.com/">http://www.event1.com/</a>   | <b>Event Electronics</b>                                |
| <a href="http://www.eviaudio.com/">http://www.eviaudio.com/</a>   | <b>EVI Audio (Electrovoice and Altec)</b>               |
| <a href="http://www.ieee.org/">http://www.ieee.org/</a>   | <b>I.E.E.E. home page</b>                               |
| <a href="http://www.livesoundint.com/">http://www.livesoundint.com/</a>   | <b>Live Sound magazine</b>                              |
| <a href="http://www.thx.com/thxmain.html">http://www.thx.com/thxmain.html</a>                                   | <b>Lucasfilm THX</b>                                    |
| <a href="http://www.mixmag.com/">http://www.mixmag.com/</a>   | <b>MIX magazine online</b>                              |
| <a href="http://www.nasca.org/">http://www.nasca.org/</a>   | <b>National Systems Contractors Association</b>         |
| <a href="http://www.rane.com/">http://www.rane.com/</a>   | <b>Rane Corporation</b>                                 |
| <a href="http://www.cybernetusa.com/riverbank/contact.htm">http://www.cybernetusa.com/riverbank/contact.htm</a> | <b>Riverbank Acoustical Laboratories (tuning forks)</b> |
| <a href="http://www.sennheiserusa.com/">http://www.sennheiserusa.com/</a>                                       | <b>Sennheiser</b>                                       |
| <a href="http://www.sonic.com/">http://www.sonic.com/</a>   | <b>Sonic Solutions</b>                                  |
| <a href="http://www.syntrillium.com/index.htm">http://www.syntrillium.com/index.htm</a>                         | <b>Syntrillium Software (inexpensive DAWs)</b>          |

Name \_\_\_\_\_ date: \_\_\_\_\_

**Fundamentals of Acoustics and Audio**

INSTRUCTOR: DREW DANIELS

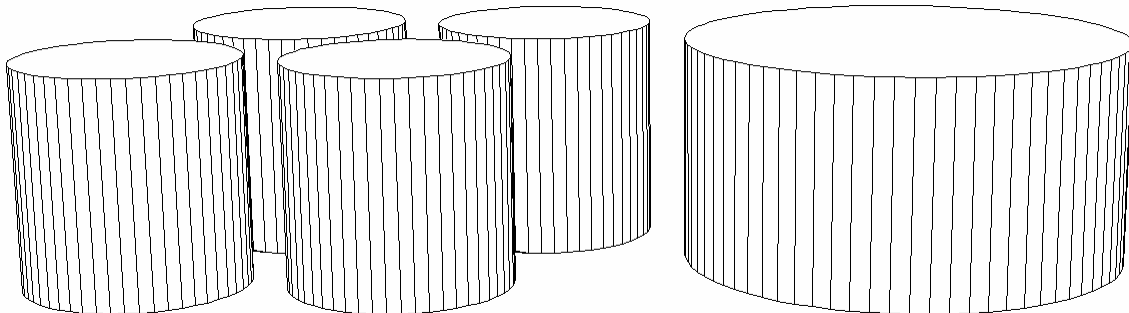
UCLA EXTENSION ESPA COURSE NO. X441.3

**Where Am I now? Quiz**

**CIRCLE or WRITE IN your best answer, estimate or guess:**

1. Which is faster: light or sound? [A] light [B] sound
2. What does the “VU” designation on audio meters stand for? \_\_\_\_\_
3. Studio Monitor loudspeakers should first: [A] be accurate or [B] sound good
4. Microphones are transducers [A] true [B] false
5. Loudspeakers are transducers [A] true [B] false
6. Lightbulbs are transducers [A] true [B] false
7. Should recording engineers do “proper engineering” regardless of the particular music? \_\_\_\_\_
8. How many record producers does it take to change a light bulb? \_\_\_\_\_
9. What is a panorama potentiometer? \_\_\_\_\_
10. Five-point-one (5.1) stereo refers to what common system \_\_\_\_\_
11. What is a “subwoofer” for? \_\_\_\_\_
12. Decibels are: [A] a ratio [B] a set of numbers [C] science-fiction [D] really loud
13. How far away is the moon? [A] 250 miles [B] 250,000 miles [C] 2.5 million miles (*if you don't know, guess.*)
14. If I.Q. was proportional to weight, fat people would be: [A] dumber [B] smarter [C] lighter
15. Name one example each of a sound absorbent material and a sound reflective material \_\_\_\_\_

16. Which will hold more water?  
 The four smaller containers are each 6 cm diameter and 6 cm high. Large container is 12 cm diameter and 6 cm high.



correct perspective view, drawn to exact scale

Answer: [A] one container [B] same volume [C] four containers