

***The Sound System Design Primer*—by Josh Loar**

Quiz Questions and Class Exercises (Grouped by Chapter)

NOTE: the following material will be presented by chapter, and each chapter will feature quiz questions on the material contained therein. Questions will be in one of three basic types: 1) Multiple-choice, 2) Simple Answer/Fill in the Blank, 3) Equations or Complex Answer. It should be evident from reading each question which type it is. *Some*, but not all, chapters will also feature suggested classroom exercises/projects for teachers. Each Chapter will be formatted as such:

CHAPTER X:

Questions:

Exercises:

If there are no exercises for a given chapter, it will simply read “Exercises: N/A”

CHAPTER 1:

Questions:

- 1) Which of the following is NOT a standard element of an analog sound system?
 - a. Inputs
 - b. Outputs
 - c. Clocking
 - d. Processing
- 2) A microphone can be classed as which type of device?
 - a. Rectifier
 - b. Transducer
 - c. Digitizer
 - d. Transistor
- 3) Which of the following is not an input source?
 - a. Microphone
 - b. Playback Computer
 - c. DI Box
 - d. Power Amplifier

Exercises:

- 1) Have students break into pairs or groups, and identify sound devices and systems with which they are familiar. Once they have identified three sound systems (anything from their phones to a concert system), they must then identify the four standard analog elements from among their systems’ components.

CHAPTER 2:

Questions:

- 1) An A/D converter performs which of the following tasks?
 - a. Cleans up audio signal
 - b. Takes digital audio and converts it to electronic (analog) audio signal
 - c. Senses electronic (analog) audio signal and generates numeric data to represent it
 - d. Fixes hums induced by DC offset problems
- 2) What is a channel strip on a mixing console?
- 3) Which of the following is NOT an advantage of digital audio systems over analog systems?
 - a. More flexible control options
 - b. Less delay/latency in the system
 - c. More flexible routing
 - d. Less hardware needed for effects
- 4) Clocking, in a digital audio system, performs which function listed below?
 - a. Aligns sample rates of different digital audio devices
 - b. Rectifies AC current to DC current
 - c. Measures amplitude of incoming digital audio signals for assignment to digital bits
 - d. Ensures all devices show the same time/date

Exercises:

- 1) Connect two digital audio devices, such as a computer with hardware interface and a mixing console. Connect the mixing console to speakers (amplifiers as well, if the speakers are passive). Set the internal clock of the computer and the console at different sample rates. Play digital audio over digital connections and listen to the problems (“jitter”), then set the clocks to the same sample rate, and listen to the improvement.
- 2) If such gear is available, connect a system as above with playback computer, console, and speakers. Play audio. Then, connect the console and hardware interface to an external word clock (like an Apogee Big Ben) and play the same audio. Compare clarity. On most devices, the external clock will allow the system to produce clearer audio.

CHAPTER 3:

Questions:

- 1) What is the idealized frequency range of human hearing?
 - a. 20MHz-20,000MHz
 - b. 20Hz-20kHz
 - c. 20kHz-20,000kHz
 - d. 100Hz-20MHz
- 2) Hertz (as a term) means:
 - a. Cycles of vibration per second
 - b. Cycles of vibration per minute
 - c. Milliseconds per cycle of vibration
 - d. A rental car company

- 3) In a harmonic sequence consisting of 200Hz, 400Hz, 600Hz, and 800Hz, 400Hz would be referred to as:
 - a. First harmonic
 - b. Second harmonic
 - c. Partial harmonic
 - d. Definite harmonic
- 4) The speed of sound, at 68° F, 50% barometric pressure and humidity, is:
 - a. 343 ft/sec
 - b. 1000 ft/sec
 - c. 2000 ft/sec
 - d. 1125 ft/sec
- 5) 0 dB SPL is also referred to as _____.
- 6) An average human conversation is about _____ dB SPL.
 - a. 30
 - b. 65
 - c. 75
 - d. 100
- 7) The difference between the loudest and softest parts of selected audio content is called:
 - a. The loudness range
 - b. Effective loudness
 - c. Dynamic range
 - d. Loudness threshold
- 8) We have a speaker producing 110 dB SPL, measured at 1 meter, powered at full continuous power. How loud will that speaker be when powered at full, measured at 7.5 meters?
- 9) We have a speaker producing 121 dB SPL at 1 meter, full power. How loud will that speaker be, at full power, measured at 3.7 meters?
- 10) What is the wavelength of 2000Hz?
- 11) What is the wavelength of 20Hz?
- 12) In order for a sound to truly reflect off of a surface, not to diffuse, how large must the surface be compared to the wavelength of the sound?
 - a. 1x or greater
 - b. 3x or greater
 - c. 4x or greater
 - d. 7x or greater
- 13) If sound hits a surface at 30°, but bounces off at 45°, it is said to have:
 - a. Reflected
 - b. Diffused
 - c. Refracted
 - d. Diffracted
- 14) Which type of material will likely be the worst acoustic absorber?
 - a. Wood
 - b. Steel
 - c. Foam
 - d. Fabric
- 15) “Comb filtering” is so called because:
 - a. The summed waveform of two out-of-phase signals looks like the teeth of a comb

- b. This acoustic problem requires a special “comb filter” to correct in a digital audio system
 - c. It was first discovered by Sir Reginald Comb
 - d. The filter applied changes what frequencies it is operating on every few seconds, “combing” the content for problems
- 16) Which of the following are acoustic reasons we can localize a sound in a three-dimensional field (select all that apply)?
- a. Sounds to one side of us arrive at the closer ear sooner than the farther ear.
 - b. High frequency parts of a sound to one side of us will be absorbed, so one ear gets less HF as part of the sound.
 - c. Sound is actually associated with a small, nearly invisible, burst of light, which we detect subconsciously.
 - d. Sound to one side of us will be louder at the first ear it hits, and quieter on the other side.

Exercises:

- 1) Measure the distance between the first row of seating in the classroom and the rearmost row (or the back of the room, if there is only one row). Use the inverse square law to calculate projected SPL difference of a signal from the front measurement to the back. Then, play a test signal like pink noise through a speaker aimed at the seating area of the room. Use an SPL meter to measure the difference and see how closely it tracks to the projected calculations. If the numbers are similar, great! If they are very different, make sure the SPL meter is properly calibrated, recheck your math, and then explore what about the room might be changing the anticipated levels to the measured (e.g. is there a resonant cavity, like a big empty cabinet, in the space that is adding level? Are there cancellations from reflections taking place? Is the speaker highly directional, so fall-off is a bit less than expected? Etc.)
- 2) Using a sine wave generator, played through a full-range, flat-response speaker system (20Hz-20kHz), play tones starting at 20 Hz, and moving up octave by octave through the whole audible range. Play all tones at the same acoustic level, and see which frequencies the students feel are louder than others (their impressions should track the equal loudness contours, meaning they feel the extremes of high and low frequencies aren't as loud as the 1kHz-6kHz range, where our ears are most sensitive).
- 3) Choose a high frequency, such as 5kHz. Using a sine wave generator, and a directional speaker, play the frequency and aim the speaker at various surfaces. Make sure to have surfaces that represent the range of acoustical responses possible (with the exception of refraction). Aim at a large (4x wavelength of 5kHz or greater) object, and have students move around the room, identifying the points in space where the sound seems to be coming from the reflecting surface rather than the speaker. Aim at progressively smaller objects until the objects have no effect on the path of the sound (they diffract around). Same can be done with LF signal, exploring the fact that true LF is very hard to reflect, and just bends around objects.
- 4) Measure SPL for a balloon popping at various distances and positions, versus measuring SPL for a very directional speaker playing an HF signal in one direction (to show the difference between on-axis and off-axis HF coverage, versus a truly omnidirectional source).

CHAPTER 4:

Questions:

- 1) Charge in an electrical circuit flows from:
 - a. Positive to negative
 - b. Negative to positive
 - c. Whichever way you tell it to flow
- 2) The standard unit for measuring potential energy is:
 - a. Wattage
 - b. Amperage
 - c. Voltage
 - d. Resistance
- 3) Which of the below values are denominated in Ohms (select all that apply)?
 - a. Electromotive force
 - b. Resistance
 - c. Current
 - d. Impedance
- 4) If you have a 115V wall socket, and connect to it an incandescent lightbulb (with no dimmer) that has a fixed resistance of 44 Ohms, how much current will that lightbulb draw?
- 5) If you have a lightbulb drawing 2.6 amps, connected to a circuit providing 115V of potential energy, what is the wattage of that bulb?
- 6) A “ground” wire in an electrical system eventually connects to:
 - a. Nothing, it drains unused electricity into the air
 - b. A metal pipe or rod sunk into the literal earth
 - c. A power station in your neighborhood
 - d. An electrical “grinder” that wears out unused electricity till it dissipates
- 7) A short circuit happens when:
 - a. The neutral wire is shorter than the hot wire in a circuit
 - b. The polarity of an electrical device is flipped
 - c. Electricity finds a path of less resistance to ground and takes it
 - d. In a Johnny 5 scenario
- 8) A microphone features a stable charged field that is induced to fluctuate when:
 - a. A power source is attached to it
 - b. Sound hits the diaphragm, causing it to move and thus vary the field
 - c. Inverse current flux is rectified
 - d. Resistance is increased via the phantom power switch

Exercises:

- 1) Using a multimeter with a resistance test setting, connect the leads to a standard 60W incandescent lightbulb and measure its resistance. Do the same with an 8 Ohm speaker driver, noting that it won't measure 8 Ohms in a stable test, because 8 Ohms is an *averaged impedance* measurement for a signal that varies in frequency, and thus the speaker will vary in impedance while operating.

- 2) Build Edison extension cables with NEMA 5-15 ends (one male, one female), with students cutting and stripping the wire, seating the connections, and testing with a light-up circuit tester.

CHAPTER 5:

Questions:

- 1) The process of converting analog audio signal to digital audio signal involves assigning individual data points to each amplitude and frequency of input. This process is known as:
 - a. Flux coding
 - b. Discretizing
 - c. Muxing
 - d. Multiplexing
- 2) Which area of frequency will be lowest-fidelity in a digitally sampled signal with sample rate of 44.1kHz?
 - a. Low frequencies
 - b. Mid frequencies
 - c. Sub-bass frequencies
 - d. High frequencies
- 3) What is the alias frequency generated when using a sampling frequency of 40kHz, and recording a signal at 37kHz?
 - a. 17kHz
 - b. 20kHz
 - c. 3kHz
 - d. 7kHz
- 4) In digital audio, bit depth most directly correlates to which of the following properties of an audio signal?
 - a. Dynamic range
 - b. Frequency range
 - c. Transient response
 - d. Slew rate
- 5) The correct expression of the decimal number 192 in binary is:
 - a. 10110101
 - b. 11000000
 - c. 10100000
 - d. 01111111
- 6) How much data storage do you need in order to record 7 tracks of audio, at 44.1kHz sample rate, 16 bit, for 3 minutes?
 - a. 106 Mb
 - b. 106 Gb
 - c. 1.06 kb
 - d. 106,000 Mb

Exercises:

- 1) Calculate further digital audio storage values, based on real production needs and examples (e.g. a concert with 24 mics onstage, that is 2 hrs long, recorded at 48kHz/24bit).

CHAPTER 6:

Questions:

- 1) Which microphone types are NOT powered by permanently charged magnets (select all that apply)?
 - a. Dynamic
 - b. Condenser
 - c. Ribbon
 - d. Piezoelectric
- 2) The thin membrane that vibrates with acoustic sound pressure, that causes charge to fluctuate and thus analog audio to travel into a system from a microphone, is called:
 - a. Cone
 - b. Tympanum
 - c. Diaphragm
 - d. Portal
- 3) The device that a microphone connects to, that raises its signal level to a usable value, is called a:
 - a. Mic jack
 - b. Preamp
 - c. Line in
 - d. Insert jack
- 4) In a dynamic mic, the diaphragm is connected to the _____, which moves back and forth, cutting against the stable magnetic field, and thus inducing current to flow.
 - a. Pole piece
 - b. Housing
 - c. Voice coil
 - d. Terminal strip
- 5) Which of the following mic types is likely to have the fastest transient response?
 - a. Condenser
 - b. Piezo
 - c. Dynamic
 - d. Ribbon
- 6) Which of the following is NOT a characteristic of a typical ribbon mic?
 - a. Smooth tone
 - b. Slow transient response
 - c. Needs phantom power
 - d. Magnetic engine
- 7) Phantom power, which is needed for condenser mics, is:
 - a. Provided by the mic itself
 - b. 48V DC from the preamp/console
 - c. 5V AC from the preamp/console
 - d. Always on in devices that provide it

- 8) A condenser mic is generally more fragile than a dynamic mic. The reason for this is:
 - a. It is not as expensive
 - b. It is not as well-made
 - c. It contains a piece made of thin glass
 - d. It contains a piece made of ceramic

- 9) Which of the following is the narrowest polar pattern?
 - a. Cardioid
 - b. Omni
 - c. Hypercardioid
 - d. Bidirectional

- 10) Directional microphones evince a particular acoustic effect when performers or subjects are very close to the mic diaphragm, which omni mics don't evince. This is called "proximity effect". Its sonic result is:
 - a. More high frequency response
 - b. An ugly "boxy" tone
 - c. Overload/distortion
 - d. More low frequency response

- 11) The phenomenon known as "feedback" happens when:
 - a. A piezo mic is used where a condenser should have been used
 - b. A mic's signal runs through a speaker, back into the mic, back into the speaker, in a loop
 - c. A mic's signal is summed with its out of phase opposite in a mixing console
 - d. Anyone taps a mic, ever

- 12) Handheld mics are a subtype of what form factor?
 - a. Side address
 - b. Sub-miniature
 - c. Rear address
 - d. Front address

- 13) Given two mics, one with a sensitivity spec of "1.85mV/Pa" and the other with a sensitivity spec of "22mV/Pa", which of the two is likely to be a dynamic, and not a condenser?

Exercises:

- 1) Microphone shootout: gather a wide range of different mics of different types and patterns into a studio space. Connect them all to the same type of preamps (using a mixing console is great for this), or set them up so you can repatch them to the same preamps. Have a volunteer speak into each mic, starting from about 3' away, and moving very close to the diaphragm (within an inch), listening for proximity effect (or lack thereof). Have them walk around the mic in a circle while talking, and witness the polar patterns. Play a small range of acoustic instruments into each mic (I like to use an acoustic guitar, a hand drum of some kind, and something in the wind/reed/brass family, all handheld instruments). Discuss how each sounds, and what the advantages or disadvantages of each might be in a given context. Try setting the same preamp gain from a condenser on a dynamic, and witness how much added gain must be used to get them to transmit at equivalent levels. NOTE: this exercise works MUCH better if the listening space is a true control room (isolated from the space with the mics) than in a

small room where mics and speakers are both located. It is also much easier to tell differences in good speakers, rather than through headphones.

CHAPTER 7:

Questions:

- 1) Which of the following is NOT a standard component part of a wireless mic system?
 - a. Mic
 - b. Transmitter
 - c. Ballast
 - d. Antenna
- 2) A producer wants a wireless Neumann U87, what feature does your plug-end transmitter need to provide in order to make this work?
 - a. FET circuitry
 - b. Valve circuitry
 - c. Ghost load
 - d. Phantom power
- 3) Microphone “caps” are sometimes used with lavalier elements to do what?
 - a. Change the color of the element
 - b. Change the frequency response
 - c. Change the physical shape
 - d. Change the dynamic range
- 4) Which of the following is NOT a common supply used for mounting wireless mic elements?
 - a. Hellerman sleeves
 - b. Elastic
 - c. Solder
 - d. Floral wire
- 5) What government body regulates the radio transmission bands used by wireless mics in the United States?
 - a. FTC
 - b. FEC
 - c. FDA
 - d. FCC
- 6) “Antenna diversity” means:
 - a. A system with more than one type of antenna used at the same time
 - b. A system with two matching antennae, that uses whichever signal is stronger at any given time
 - c. A system with more than one mic transmitting on the same frequency, with sophisticated decoding at the receiver to split the signals back out
 - d. A system with both helical and parahelical antennae
- 7) The technical name for a “paddle” antenna is:
 - a. Omnidirectional
 - b. Bidirectional
 - c. Log periodic
 - d. Helical

- 8) In a professional setting, when should the user change the batteries in wireless transmitters?
 - a. When they are below $\frac{1}{4}$ full according to the computer monitoring system
 - b. When they are below $\frac{1}{2}$ full according to the computer monitoring system
 - c. Every other rehearsal/performance day, or option A above, whichever comes first
 - d. Every rehearsal/performance, at the start of the work call

Exercises:

- 1) Practice mic mounting with lavaliers. Try different mounts, in different hair types. Have the mic hooked up to a sound system, so the effect of different mic positions can be heard (crown mount vs cheek mount vs over-ear mount, etc.) Put hats on and take them off, listen to the difference. Practice shaping earpieces with floral wire and Hellerman sleeves.
- 2) Using several network-enabled mic receivers, connect them to a computer network and wireless monitoring software (that varies by brand). Practice reading and understanding the data from the software.
- 3) Practice setting transmission/receiving frequencies (on units where this is selectable). Set two mics to the same frequency, and listen to the resulting intermodulation distortion, such that this sound is one the students recognize on its own.

CHAPTER 8:

Questions:

- 1) Which of the following is nominal “professional” line level?
 - a. -10dBV
 - b. +10dBu
 - c. +4dBu
 - d. -4dBu
- 2) A typical DI box changes instrument level to:
 - a. Speaker level
 - b. Line level
 - c. Mic level
 - d. Digital level
- 3) The difference between a turntable DI and a standard stereo DI is:
 - a. The turntable DI has anti-skid functions
 - b. The turntable DI has different frequency response and a spot to connect a ground wire
 - c. The turntable DI is the same as a stereo DI, just marketed at DJs
 - d. The turntable DI inverts the polarity of the left channel, for noise reduction in transmission

Exercises: N/A

CHAPTER 9:

Questions:

- 1) When using a digital playback device, which of the following file formats is least desirable for content?
 - a. AIF
 - b. MP3
 - c. WAV
 - d. OGG
- 2) If you are designing a system that requires continual playback, 24/7 (such as an airport lounge), which of the following playback solutions is most likely to meet your needs?
 - a. Laptop-based QLab system
 - b. CD player
 - c. Desktop-computer-based QLab system
 - d. Media server system
- 3) A device or software program that sends messages to playback devices telling them when to play content, what content to play, and in what manner, is called:
 - a. Sound manager
 - b. Show controller
 - c. Programming agent
 - d. Timespan controller
- 4) A system that features two parallel playback devices, playing identical content in real time, to provide a backup in case of failure, is referred to as a:
 - a. Two-fold system
 - b. Diversity system
 - c. Redundant system
 - d. Multilane system
- 5) A set command that makes a given sound play upon receipt of this command, is called a:
 - a. Fire-prompt
 - b. Trigger
 - c. Fuse cue
 - d. Timedrop

Exercises:

(Note: all of these suggest using QLab, because it is readily available and quite common. However, these exercises could be accomplished using the PC-based SFX software, using a media server, or a host of other parallel solutions for computerized playback).

- 1) Using a Mac running QLab, program a sequence of cues, one of which will be fired by hotkey trigger, one of which will be fired by external MIDI controller, one of which will be fired by spacebar, one of which will be fired by wall clock. Make sure all are working.
- 2) Using a Mac running QLab, set a series of cues to fire when prompted by OSC triggers, fired from a show controller (software or hardware).
- 3) Using a Mac running QLab, create a large group cue with multiple simultaneously fired “children” inside of it. Make one cue of this type with AIF or WAV files, and another with MP3s. Keep adding children until the cue crashes, or playback is delayed from firing to the hearing of sound. Use the same content for both cues, just encoded as different file types. See which crashes or delays first (typically, it will be the MP3s that choke first, due to the “unwrapping” that must take place before playing can commence,

but in rare cases, both will start choking at the same time, when you have simply reached the maximum limit of what the computer's RAM can handle).

CHAPTER 10:

Questions:

- 1) The "gain" knob at the top of a typical channel strip is controlling the signal level of the:
 - a. Preamplifier
 - b. Channel output
 - c. First band of EQ
 - d. Compressor output
- 2) When sending signal through an audio device we want to maximize the:
 - a. Dynamic range
 - b. Frequency balance
 - c. Signal to noise ratio
 - d. Auxiliary power
- 3) An aux send used to control stage monitors is typically run in:
 - a. Pre-fader mode
 - b. Post-fader mode
 - c. Stripped-fader mode
 - d. FX mode
- 4) In what mode is the "solo" function used when setting mic gain?
 - a. AFL
 - b. PFL
 - c. SIP
 - d. SAP
- 5) A channel's "assigns" can send a signal from a channel to (select all that apply):
 - a. The Left/Right mix
 - b. Subgroup/bus outs
 - c. Aux sends
 - d. Inserts
- 6) Which of the below is NOT a common feature of a console's master section?
 - a. Bus/group faders
 - b. Main faders
 - c. Aux send masters
 - d. Limiters
- 7) Which of the below features is NOT a common advantage of digital consoles?
 - a. Scene programming/recall
 - b. Built-in effects
 - c. Less expensive than analog consoles on average
 - d. More flexible routing than analog consoles on average

Exercises:

- 1) Build small practice sound system kits, centered on small but full-featured consoles (like the Mackie 1604, the Behringer Xenyx series, or the like). Each kit should feature a dynamic mic, a condenser mic, a battery-powered guitar practice amp, a pair of cheap

computer speakers, an outboard EQ, and an outboard reverb. These kits allow students to practice setting proper mic gain structure, routing signals (the computer speakers can be used as L/R mains, the battery powered amp can serve as destination for aux sends in pre, or sub/bus outs. The outboard EQ can work as an insert effect, and the reverb can be routed to via aux in post, and returned to other channels.

CHAPTER 11:

Questions:

- 1) A spectral effect operates on:
 - a. Dynamic range
 - b. Time domain
 - c. Frequency response
 - d. Distortion
- 2) A high- or low-pass filter is often described both in terms of cutoff frequency and slope. Slope is usually described in what terms?
 - a. Q
 - b. Gain
 - c. Frequency order
 - d. dB/octave
- 3) Which of the following is NOT a control found in parametric EQs?
 - a. Gain
 - b. Slope
 - c. Q
 - d. Frequency
- 4) The basic purpose of a compressor is:
 - a. To reduce overall level
 - b. To widen dynamic range
 - c. To narrow dynamic range
 - d. To filter out low-level signals
- 5) A compressor's threshold determines:
 - a. How much gain is applied to the compressed signal
 - b. At what intensity signal level begins to be limited
 - c. The frequency cutoff for dynamic control
 - d. The intensity of the signal reduction
- 6) The principle that allows an effect on Channel 1 to be triggered by the sound on Channel 2 is known as:
 - a. Side-chaining
 - b. Side-leveling
 - c. Back-chaining
 - d. Parallel chaining
- 7) A flanger is a _____ effect.
 - a. Dynamic
 - b. Drive
 - c. Analytical
 - d. Modulation
- 8) Creative mixing effects are perhaps least abundant in what type of production?

- a. Seminar
- b. Rock concert
- c. Broadway musical
- d. Rave

Exercises:

- 1) Using any DAW, students take a song or piece of high-fidelity audio content that they are very familiar with and apply every category of effects, using parameters until they are confident they know what each effect can do. Note that using pre-mastered material will make the use of dynamic effects difficult, unless the content is already highly dynamic (like classical music or some jazz).
- 2) Using multitrack recordings of drums and bass, practice side-chain compression on either the kick drum or bass, triggered by the other.

CHAPTER 12:

Questions:

- 1) A crossover in a sound system is often used to:
 - a. Send drums to separate speakers from bass
 - b. Split full-range signal between subwoofers and top speakers
 - c. Split signal between the main hall and the lobby
 - d. Send signal to both a live system and a recording rig
- 2) A DSP is used for “tuning” a system. Tuning a system consists of several basic steps. Which of the following is NOT a basic step of system tuning?
 - a. Frequency leveling
 - b. Time-alignment of speakers/signals
 - c. Reverb settings
 - d. Speaker protection/limiting
- 3) A DSP is generally found at what point in a sound system’s signal flow?
 - a. Between the input and the processing stages
 - b. Between the amplification and output stages
 - c. Between the processing and amplification stages

Exercises:

- 1) The best way to learn about DSPs is to use them. Download free configuration software for a DSP you have access to. Program simple signal flows with all the major processing objects (delay, EQ, limiting), and connect the DSP to an input source and a powered speaker. Run your software configuration live and make sure that the signal makes it where it is supposed to go, and that you understand how to operate the controls of each processing object.
- 2) Create a control architecture (whether via scripting or ladder logic or whatever is native to your DSP platform) that allows you to use a touch panel to control signal levels, routing, mute/unmute, etc.

CHAPTER 13:

Questions:

- 1) Why do we generally place a delay before an EQ in a DSP signal path?
 - a. We don't, delays go after EQs
 - b. Because poor time-alignment often shows up as frequency errors, so we want to correct timing before trying to correct frequency
 - c. Because delays take more processing power, so we need to use them first and allocate whatever DSP power is left to EQs
 - d. Because we set components in alphabetical order
- 2) A sonic artifact is:
 - a. A rare sound from the 1950s or earlier
 - b. A sound that is particularly artful or hand-made
 - c. New and undesirable sonic material introduced to a signal
 - d. All of the original Telefunken mics still in existence
- 3) If we have a main and underbanc speaker set, each playing the same content, but we don't delay the underbanc, where will the audience seated under that balcony localize to?
 - a. The main speaker
 - b. The actors onstage
 - c. The rear wall reflection
 - d. The underbanc speaker
- 4) A second-order filter has a default slope of:
 - a. 6dB/oct
 - b. 12dB/oct
 - c. 18dB/oct
 - d. 24dB/oct
- 5) When setting a limiter to protect a speaker from overload, best practices involve (in part):
 - a. Playing pink noise through the speaker till you reach max SPL
 - b. Playing pink noise through the speaker till you reach 5dB below stated max SPL
 - c. Playing pink noise through the amp channel, and setting a max level with a multimeter
 - d. Playing music through the amp channel, and setting a max level with a multimeter

Exercises:

- 1) Using a DSP, a multimeter, a power amplifier, and a passive speaker, follow the limiter-setting procedure as stated in the chapter, and set up a speaker-protection control. Then run signal (noise, music, whatever) through that system, turning level up until it hits the limiter threshold, and measure the SPL versus anticipated max SPL. If done properly, this usable max SPL should be close to the printed spec max SPL (though likely not all the way to that max SPL, since you are setting a limiter to prevent quite reaching it).
- 2) Create a single signal path through a DSP. Install one of every type of audio processing object available into that signal path. Then, running music or some other pleasant signal through the path, utilize every single available control until you understand the whole range of options within that device.
- 3) Create 4 parallel signal paths through a DSP, and make a custom control that will mute/unmute all 4 at once with a single button press. This will help you learn the logic/scripting/control architecture of your particular DSP.

CHAPTER 14:

Questions:

- 1) If you have a loudspeaker with a sensitivity spec reading “91 dB SPL @ 1W, 1M”, and its stated max continuous power handling is 625 W, how loud will this speaker be when powered at full, measured at 1M?
- 2) In an ideal system, an amplifier’s power relationship to a speaker’s power handling capabilities would be:
 - a. Underpowered, the speaker can handle more power than the amp can provide
 - b. Matched exactly, the speaker’s max power handling is exactly what the amp can provide
 - c. Slightly overpowered, the amp can provide a little more power than the speaker can handle
 - d. Clearly overpowered, the amp can provide a lot more power than the speaker can handle
- 3) What is a baseline minimum number for dB of headroom desirable in a system?
 - a. 6dB
 - b. 12dB
 - c. 18dB
 - d. 24dB
- 4) If you have (4) 16-Ohm speakers, and you want to power them with one amplifier channel, which has a stated operating impedance range of between 4 and 16 Ohms, what is the preferred way to combine them?
 - a. Series
 - b. Parallel
- 5) When a speaker suffers continual heat overload, what is a possible result?
 - a. Fire
 - b. Voice coil melts, no sound, infinite resistance
 - c. Voice coil shatters, screeching sound, no resistance
 - d. Dark scorch marks inside the driver
- 6) If you combine (6) 8-Ohm speakers in series, what is the resulting impedance?
 - a. 48 Ohms
 - b. 1.33 Ohms
 - c. 14 Ohms
 - d. 3 Ohms
- 7) If you combine (6) 8-Ohm speakers in parallel, what is the resulting impedance?
 - a. 48 Ohms
 - b. 1.33 Ohms
 - c. 14 Ohms
 - d. 3 Ohms
- 8) Why don’t we generally run amplifier channels with 2-Ohm loads?
 - a. We do, this is not a problem
 - b. There are no professional amplifiers that can handle 2-Ohm loads
 - c. Impedance is frequency-dependent, and 2 Ohms can easily fluctuate to nearly 0, which is dangerous
 - d. There is no speaker configuration which will result in a 2-Ohm load

- 9) If you have a 5,000 W amp channel, that can handle 4-16 Ohm loads, and an endless supply of 8-Ohm, 50 W speakers, what is the maximum speaker count that can be powered by this channel, and what is one possible configuration that will keep the load within proper operating range? What is the final load impedance?
- 10) Why don't we use 70V systems in concert work (generally)?
 - a. We do, all the time!
 - b. 70V systems tend to have lower audio fidelity
 - c. 70V systems are poor at heat distribution, which doesn't work well inside concert halls
 - d. 70V systems are too low-powered for concert work

Exercises:

- 1) Create more sample equations, and run the math to be sure you understand all the examples in the chapter.
- 2) Imagine you have a speaker whose sensitivity is "87 dB SPL, 1W, 1M". If you need to run this speaker no hotter than 99dB SPL, determine how much wattage you need from an amplifier in order to reach that level. You will be using the 10log equation, but flipping it around:

$$12dB\Delta = 10\log_{10} \frac{x}{1}$$

We are solving for x. First, divide both sides by 10:

$$1.2dB\Delta = \log_{10} \frac{x}{1}$$

Next, we know that any number divided by 1 is itself, so we can rationalize our fraction:

$$1.2dB\Delta = \log_{10} x$$

Then, we turn the log into an exponent:

$$x = 10^{1.2}$$

Then, we calculate the value of 10 to the power of 1.2, which is 15.84...

So we know we need 15.84 watts of power to achieve a gain of 12 dB with this particular speaker and its sensitivity. If we want to check our work, we can use the guideline that states that for every 3dB of gain, we must double power. From 1W to 2W, we go from 87 dB SPL to 90. From 2W to 4W, we go from 90 to 93. 4W to 8W gives us 96. Then 16W gives us 99! 16 W is pretty close to 15.84, so we know we're doing our math correctly.

Create other scenarios like this and run the math again, to be sure it is understood.

CHAPTER 15:

Questions:

- 1) The power amplifier class with the highest level of signal fidelity is:
 - a. Class A
 - b. Class B
 - c. Class AB
 - d. Class D
- 2) Bridge mode is typically used for what kind of speaker?
 - a. Point source
 - b. Line array
 - c. Columnar array
 - d. Subwoofer
- 3) What is the minimum acceptable damping factor for a professional power amp?
 - a. 100
 - b. 200
 - c. 400
 - d. 1000
- 4) If you are planning to play very quiet ambient sound effects through an amp, what specified “feature” of some Class D amps might impede your success?
 - a. High noise floor inherent in Class D
 - b. Bias current audible at low levels in Class D
 - c. Class D level threshold
 - d. Class D dynamic boost compression
- 5) True or false: a UPS never serves as a power conditioner
 - a. True
 - b. False
- 6) UPSs have a maximum available battery runtime of:
 - a. 10 hrs
 - b. 10 minutes
 - c. 10 seconds
 - d. this is not a thing

Exercises: N/A

CHAPTER 16:

Questions:

- 1) The part of a speaker that features the cone and coil (among other bits) is called:
 - a. Basket
 - b. Cabinet
 - c. Driver
 - d. Spider
- 2) The voice coil is coupled physically to what part in order to drive the excursion?
 - a. Spider
 - b. Surround
 - c. Basket
 - d. Cone

- 3) The voice coil is held in shape between the magnetic poles by a piece called the:
 - a. Former
 - b. Basket
 - c. Spider
 - d. Surround
- 4) A baffle is:
 - a. A confusing speaker design
 - b. An object designed to reduce airborne sound
 - c. An out-of-phase passive driver
 - d. Another name for a port or vent in an enclosure
- 5) The phase response of a sealed enclosure is typically:
 - a. Worse than a ported enclosure of equivalent size/materials
 - b. The same as a ported enclosure of equivalent size/materials
 - c. Better than a ported enclosure of equivalent size/materials
 - d. Completely immaterial, it has no bearing on phase response, which is entirely up to the driver design
- 6) Typically, a speaker is designed with a port or vent in order to:
 - a. Make it lighter-weight
 - b. Give it clearer high frequency response
 - c. Look cooler
 - d. Produce more low frequency response
- 7) A speaker design that includes a driver that is not wired up to receive signal is called:
 - a. Dummy box
 - b. Ghost box
 - c. Passive radiator
 - d. Passive inverter
- 8) The wide open end of a speaker horn is called:
 - a. Aperture
 - b. Mouth
 - c. Throat
 - d. Bolus
- 9) In your own words, why does sound follow a waveguide?
- 10) A 2-way speaker's crossover performs what function?
 - a. Filtering out subwoofer frequencies from this top speaker
 - b. Separating signal into two frequency bands for the woofer and tweeter
 - c. Inverting polarity of the HF signal to avoid comb filtering when close to the drivers
 - d. None of the above
- 11) Which of the following is NOT a benefit of bi-amping speakers?
 - a. More efficient electrical use of each driver
 - b. Cheaper than single-amping
 - c. Generally clearer phase response
- 12) An average speaker might use _____% of the input power to actually create sound, with the rest becoming backflow or waste heat.
 - a. 75
 - b. 50
 - c. 15
 - d. 25

- 13) Which of the following is NOT part of a speaker's "form factor"?
- Size
 - Weight
 - Power handling
 - Mounting type
- 14) An audience area that is wide and deep, where we want the audience to experience the same SPL in all seats, might call for:
- Point-source mains
 - Line-array mains
 - Backcan mains
- 15) A speaker built into scenery, particularly one that must be interacted with by an actor, is often referred to as:
- A junk speaker
 - A five-fold radio
 - A participator
 - A practical
- 16) If a speaker spec lists both "frequency range" and "frequency response", which is most likely to represent a flatter performance?
- Range
 - Response
- 17) A horizontal and vertical coverage pattern is generally true for:
- All frequencies a speaker produces
 - Only the high frequencies
 - Only the mid frequencies
 - Only the high and some mid frequencies
 - Only the low frequencies
 - Only the low and some mid frequencies
- 18) A speaker's spec sheet might list the crossover frequency between a tweeter and a woofer. This is relevant because:
- It isn't, it's just more info to make the speaker look fancier
 - The crossover will be the "sweet spot" of the frequency range, the clearest part of its reproduction
 - The crossover will create a little phase distortion, and thus will never be as linear as other parts of the frequency range
 - The impedance will be highest at the crossover point
- 19) How important are speakers to the performance of a sound system?
- Sort of important
 - Not terribly important
 - Fairly important
 - The most important!

Exercises:

- 1) Speaker shootout. Set up a range of speaker types and power all passive speakers with identical (or at least markedly similar) amps. Play noise and familiar content, check polar patterns, frequency response, tonal character/color, etc. Mount speakers overhead, and notice how the sound changes from mounting them straight-on, or setting them on the ground. The best way to learn what speakers sound like is to listen to a bunch of them,

especially with content that the listeners know very well. Particularly useful in circumstances like these is to find a couple of speakers whose specs are nearly identical, but are from wildly different product lines, like the EAW JF60 and the Meyer UPM-1P. On paper, these look like very similar speakers, but listening to them is a very different experience.

- 2) Set up two speakers in a stereo configuration connected to the same content. Set a delay on one, and slowly increase until the image shifts to the other side. Keep increasing until it is a distinct after-image (echo). Set delays identical again. Reduce level on one side, till stereo image shifts to other side. Delay side that is louder, and see if image can be shifted back to center without resetting levels. This is exploration of the Haas effect.
- 3) Set up two speakers running the same content. Place one at the end of a room, and the other halfway through (ideally this is a long room or theater). Work with delay on the speaker in the middle of the room until the image pulls back to the speaker at the end of the room (this exercise works better if the speakers are flown above head-height, but if you need to do this at head-height, aim the speakers 45° to the listening area, so that listeners can hear both as they sum).

CHAPTER 17:

Questions:

- 1) Monitoring systems are important for a host of reasons. Which of the below is NOT a common reason we need monitoring systems?
 - a. Band members need to hear one another
 - b. Crew needs to hear the show backstage
 - c. Performers need to monitor election results backstage
 - d. Singers need to keep in sync with a remote orchestra
- 2) A large, bass-only speaker, typically aimed at a drummer, is called:
 - a. Drum bus
 - b. Drum sub
 - c. Drum wedge
 - d. Drum fill
- 3) Broadway orchestra members are often outfitted with what item to help them control their earphone mix?
 - a. Attenuation pads
 - b. Wedges with volume controls
 - c. Personal monitoring systems
 - d. Mixdown function controllers
- 4) A performer in a band may need to hear their vocal performance while moving around the stage. Rather than set up a whole bank of wedges across the front of the stage, they may instead use:
 - a. One stereo pair of wedges
 - b. Wireless IEMs
 - c. Wireless DCPs
 - d. DX-controls
- 5) Assisted listening systems are required of many US venues by order of what law?
 - a. The Assisted Listening Act
 - b. The Federal Hearing Assist Law

- c. The Accessibility Requirements Act
 - d. The Americans with Disabilities Act
- 6) Which type of earphones will block the most ambient noise?
- a. In-ear buds
 - b. Closed-back over-ear
 - c. Open-back over-ear
 - d. No one type is better than another, it's down to individual models and brands

Exercises:

- 1) Play loud music over speakers in a room. Play other music over earphones, swapping types to test which ones block more or less sound from the room speakers.
- 2) Place a monitor wedge on the floor. Connect it to a live mic (via an interface or console). Experiment with monitor placements and mic polar patterns to see which mics and positions get the most feedback and the least.

CHAPTER 18:

Questions:

- 1) When computers send information over networks, they break the information into small pieces called:
 - a. Chunks
 - b. Bits
 - c. Pieces
 - d. Packets
- 2) The “permanent” hardware address associated with any network interface connection is called:
 - a. IP address
 - b. Subnet mask
 - c. MAC address
 - d. Net ID
- 3) Which of the following is NOT a reserved private IP address?
 - a. 10.0.0.15
 - b. 141.123.45.12
 - c. 192.168.0.125
 - d. 172.16.1.34
- 4) LAN stands for:
 - a. Last access network
 - b. Local area network
 - c. Least active network
 - d. Local administrator NetID
- 5) If you select the DHCP option on a network device, this means that:
 - a. You have to set the IP address manually
 - b. You have elected to skip subnet masking entirely
 - c. You will be assigned an IP address that you do not choose
 - d. You will be selected as the clock master in your device network
- 6) The primary distinction between a router and a switch is:

- a. A router bridges between more than one network, a switch does not
 - b. A switch bridges between more than one network, a router does not
 - c. A router is wireless, a switch is not
 - d. None, they are names for the same device
- 7) The IP address 192.168.0.13 contains both a NetID and a HostID. Which part of the numeric set is the NetID (assuming default subnet settings)?
- a. 192
 - b. 192.168
 - c. 192.168.0
 - d. 192.168.0.1
- 8) Hardware aside, Dante audio protocol is capable of carrying how many total channels simultaneously in one feed?
- a. 32
 - b. 64
 - c. 512
 - d. 1024
- 9) True or false: you can send Dante audio to a CobraNet input?
- a. True
 - b. False
- 10) Audio equipment IP addresses are typically written in what protocol?
- a. IPv4
 - b. IPv5
 - c. IPv6
 - d. IPv7
- 11) Which of the following protocols prioritizes the time domain in message transmission, as opposed to prioritizing message completion without errors?
- a. UDP
 - b. TCP/IP
 - c. IP
 - d. DHCP

Exercises:

- 1) Set up a small collection of network-enabled gear, including but not limited to: at least two computers, a DSP, a console with network connections, and a switch (as well as a speaker to feed out of the DSP). Ideally, at least one part of the system will be Dante-enabled as well, but the activity can work without this. Connect all devices to the switch. Set IPs manually so that all devices are in the same network. Use one computer to share the screen of the other (in Macs, screen-sharing must be activated in the system preferences, in PCs, a VNC client and host must be running, one on each computer). Move files from computer to computer. Control the mixer, moving faders. Program the DSP. Send audio over Dante from a computer running Dante Virtual Soundcard to the console, to the DSP, out the speaker. Make sure each student can set up both the physical and IP patching, and route signals and control appropriately.
- 2) Set up a lighting network and a sound network. Use a router to connect between the two. Send MIDI messages to or from a lighting console. Use the message to trigger lighting cues from a QLab cue set, or vice versa.

- 3) Set up a Mac network using custom access controls (configured in the Sharing preferences). Allow some users to share screens or move files, and others to only do one or the other. Dial in with those users and make sure your access controls work as you anticipated.

CHAPTER 19:

Questions:

- 1) A show controller tells other devices what to do and when in a production system. Which of the following is NOT an action commonly triggered by a show controller?
 - a. Audio playback
 - b. Video playback
 - c. Actor entrance
 - d. Lighting cue
- 2) List four common message types used by show controllers:
- 3) The time data shown as HRS:MINS:SECS:FRAMES is known as:
 - a. Inverse timecode
 - b. Film timecode
 - c. IP codebase
 - d. SMPTE timecode

Exercises:

- 1) If you have access to a show controller, connect it to an audio device (a computer running QLab, a mixing console with network control port, etc.). Program control messages from the controller to the device(s) that will trigger actions (sounds firing, mixer presets recalled, etc.)

CHAPTER 20:

Questions:

- 1) A basic two-pole switch performs what function?
 - a. Sets an encoder to positive or negative polarity
 - b. Closes or opens a circuit path
 - c. Reads x/y position and communicates it
 - d. None of the above
- 2) An encoder can be used in which of the following modes?
 - a. Momentary
 - b. Continuous
 - c. Neither of the above
 - d. Both A & B
- 3) A position sensor can sense:
 - a. The distance of an object from the sensor in the absolute
 - b. The distance of an object from a starting position
 - c. The x/y/z position of an object in a free field
 - d. All of the above, depending on model and configuration

- 4) When selecting an electrical device to provide/generate trigger information, which of the following is NOT something you need to consider?
 - a. What type of data is delivered
 - b. What is the power source needed for the device
 - c. What color is the sensor
 - d. How many wires does the sensor need to properly deliver its data

Exercises:

- 1) If you have access to sensors or switches, and a production device that accepts GPIO data (some sound consoles, DSPs, show controllers, etc.), set up a sensor or switch (or a range of them), and practice configuring them to send data that triggers any action in the receiving device.
- 2) Create an elaborate interaction plan that requires unknown sensors and triggers. (Example: you have a room with a themed installation inside, and you want not only to trigger actions any time someone enters the room, but you want the system to automatically count how many people have entered the room, and also to track when people leave—thus we could have actions associated with certain population counts in the room, and actions associated with people leaving as well. Simple doorway trip is easy to measure with a photoelectric sensor, but actually tracking which direction someone moves across the door threshold requires at least two photo sensors, so it can be determined which trips first to see whether someone is entering or exiting. Beyond that, automatically counting the population is tough, because what if people entered side by side? Do you narrow the doorway to only accommodate one person at a time? Do you add more sensors to measure proximity and direction? Do you find more elaborate sensors that can mount overhead and read width of entering objects, such that you can create a count based on average human width? There are a number of possible solutions. The best test is to actually build this as an exercise, but even researching options can be a good learning experience).

CHAPTER 21:

Questions:

- 1) Analog com systems are often referred to as _____ systems.
 - a. Matrix
 - b. Partyline
 - c. Reticular
 - d. Null
- 2) Which of the following is NOT typically a feature of 4-channel analog com systems?
 - a. 4-channel beltacks
 - b. 4-channel base stations
 - c. Flexible talk, listen, and talk/listen controls at the base station
 - d. Call lights
- 3) Which of the following is NOT an advantage of digital com systems (as opposed to analog)?
 - a. More flexible routing
 - b. More customizable communication paths/groups

- c. Lower audio latency
 - d. High audio fidelity
- 4) Which of the following is a limitation of wireless com base stations?
 - a. No multi-channel communication
 - b. Poor nulling
 - c. Interferes with wireless microphones
 - d. Limited number of beltacks per station
 - 5) A “program” feed running through a com system is used for:
 - a. Monitoring a feed of the show in real time
 - b. Telephone communication to the outside world
 - c. Programming digital com system communication routes
 - d. Inverting the polarity of one channel to silence it in the stage manager’s headset
 - 6) True or False: Digital com system beltacks always connect to the base via EtherCon.
 - a. True
 - b. False
 - 7) Which of the following is NOT a common feature of com system wall panels?
 - a. Microphone jack
 - b. Speaker
 - c. Network port
 - d. Built-in microphone
 - 8) Which type of device is most commonly used to connect to a com system by an FOH sound engineer?
 - a. Two-ear over-ear headset
 - b. Telephone-style handset
 - c. One-ear over-ear headset
 - d. One-ear in-ear headset

Exercises:

- 1) Configure a 4-channel analog com system, and make sure you understand how each connection works. Practice setting the nulling in the system so enough is heard in each headset but there is no feedback or distracting delay.
- 2) If you have access to a digital com system, configuring and programming these can provide weeks of exercise. Imagine different scenarios and program/execute them (e.g. “the producer needs her own headset to communicate with the SM, but the SM needs to be able to shut off the producer at critical show moments”; “the star needs dedicated paging to come to stage, but should not be able to talk back to anyone”; the SM needs to be able to talk to the followspot ops alone, the lighting programmer alone, the lighting designer alone, a group with the ops and programmer, and a group with all of the lighting team”, and so on).

CHAPTER 22:

Questions:

- 1) Paging systems come in three basic types. Which of the following is NOT a basic type of paging system?
 - a. Audio-com system

- b. DSP-based system
 - c. Computer-interface system
 - d. Paging-only system
- 2) Some paging systems require access control. What are some common front-end devices that allow user access control?

Exercises:

- 1) Using a DSP, set up a playback signal traveling through from input to output at a speaker. Create a ducker (some DSPs will feature a “ducker” audio object, some require custom configuration of expanders or noise gates, but a ducker is an object that will attenuate one audio signal when it senses the presence of another audio signal at another input). Connect a live mic, as the trigger input, such that when someone talks over the live mic, the audio playing through the speaker ducks, and the voice is heard. This is a basic paging system as found in many theatrical systems.

CHAPTER 23:

Questions:

- 1) A camera aimed at a conductor in an orchestra pit, run to several monitors backstage, would be considered a:
- a. Multi-source, multi-subject system
 - b. Multi-source, single-subject system
 - c. Single-source, single-subject system
 - d. Single-source, multi-subject system
- 2) Why do video com systems often end up being the audio department’s job on stage productions?
- a. Because the audio department doesn’t have enough to do
 - b. Because there isn’t always a dedicate video department, and audio is closest in function to video of the remaining departments
 - c. Because it is assumed that audio people have also been trained in video systems
 - d. It isn’t, this is a myth

Exercises: N/A

CHAPTER 24:

Questions:

- 1) The recommended maximum length of unbalanced RCA cable runs (before too much noise builds up) is:
- a. 100’
 - b. 10’
 - c. 25’
 - d. 1000’
- 2) The recommended maximum length of balanced XLR cable runs is:
- a. 25’

- b. 50'
 - c. 100'
 - d. 1000'
- 3) CMR stands for:
 - a. Control monitor red
 - b. Common mode rejection
 - c. Central mode reverse
 - d. Change model response
 - 4) On which of the following devices would you NOT expect to find RCA jacks?
 - a. CD player
 - b. Record player
 - c. Audio interface
 - d. Cassette player
 - 5) Which of the following cable types is typically unbalanced?
 - a. TRS
 - b. TS
 - c. XLR
 - d. TT
 - 6) Why are speaker cables, which are typically unbalanced, tolerate much longer runs than other unbalanced cables (like RCA) without noise buildup?
 - a. They don't, they should never run more than 25'
 - b. They don't, but speakers are so loud that we don't notice the noise
 - c. Because the higher power of the signals and thicker insulation of the wires make them more noise-resistant
 - d. Because there are actually 4 wires, and having 2 of each signal in a twisted pair makes them more noise-resistant
 - 7) A Cat 6 cable is:
 - a. Able to carry Cat 5 and Cat 6 signals
 - b. Only able to carry Cat 6 signals

Exercises:

- 1) Have students build XLR, TS, and TRS cables from scratch (bare wire spools, they will cut to length, raw connector ends, they will solder). Test them with a cable tester, then with audio signal (sometimes a cable tester shows signal, but there's still internal noise due to loose strands in the wiring or the like).
- 2) Have students terminate network cables, BNC cables, and other more complex terminations (requires specialty tools). Test with tester and in use.

CHAPTER 25:

Questions:

- 1) The process of setting signal levels at each stage of a sound system so that signal is traveling at nominal level at each stage is called:
 - a. Gain boosting
 - b. Gain staging
 - c. Gain flattening

- d. System gaining
- 2) At every point in a signal path, we are attempting to maximize:
 - a. Reverberance
 - b. Time response
 - c. Signal to noise ratio
 - d. Edge routing noise control
- 3) During an ideal process of system verification, we seek to verify in what order:
 - a. The order that we've installed the gear
 - b. Signal flow order
 - c. Reverse signal flow order
 - d. Order is irrelevant
- 4) System verification is:
 - a. A problem-solving process when something goes wrong
 - b. Making sure everything is physically connected as needed
 - c. Testing to ensure signal passes along every path needed
 - d. Checking off each connection made on your system paperwork

Exercises:

- 1) When installing or reconfiguring any sound system, choose a new student to lead the verification process, so that everyone gets the experience.

CHAPTER 26:

Questions:

- 1) A tested system differs from a verified system in that:
 - a. It doesn't
 - b. A verified system is show-ready, a tested system hasn't set show parameters yet
 - c. A tested system is show-ready, a verified system hasn't set show parameters yet
 - d. A tested system is one that adheres to certain industry testing standards
- 2) When troubleshooting, in what order does one typically check for problems?
 - a. Signal flow order
 - b. From the spot the problem was noticed, backwards in signal flow order
 - c. From the earliest spot the problem signal enters the system
 - d. No particular order, depends on the case

Exercises:

- 1) An instructor can install a system, and purposefully create some problem areas (broken cable here, problem sample clock there, whatever you come up with). Students then test the system, and work to solve the purposefully induced problems.

CHAPTER 27:

Questions:

- 1) An FFT analyzer, in a very basic setup, compares which pair of signals?

- a. A test signal through a speaker, and music
 - b. A test signal through the computer interface, and music through the speaker
 - c. A test signal through a speaker, and a copy of that signal looped back through the interface
 - d. None of the above
- 2) Which of the following is NOT a typical requirement of a measurement microphone?
- a. Cardioid
 - b. Condenser mic
 - c. Flat frequency response
 - d. Small diaphragm
- 3) An audio interface used for system tuning must feature which of the following (select all that apply)?
- a. At least two line outputs
 - b. At least one mic input
 - c. At least one optical input
 - d. At least one line input

Exercises: N/A

CHAPTER 28:

Questions:

- 1) When measuring a speaker's performance, we want to measure more than one position within its coverage area. Why?
- a. This is a myth, we measure at the center of the on-axis coverage, and EQ for that spot
 - b. We need to make any frequency changes based on an average of measurements across the whole coverage area, to maximize coverage for all listeners
 - c. We need to shape all-pass filters to create maximally flat SPL across the speaker's coverage area
 - d. Superstition?
- 2) Which induces more phase problems?
- a. A steep-sloped filter
 - b. A wide, gentle filter
 - c. Neither, necessarily
- 3) When EQ-ing a system, best practices dictate that we:
- a. Boost anywhere a speaker is performing below the zero average line
 - b. Reduce problem frequencies with a sharp notch filter
 - c. Use reductive EQ only, as gently as possible
 - d. All of the above
- 4) A speaker damaged by peak overload typically evinces what problem?
- a. Melted voice coil
 - b. Tears in the cone, spider, or surrounds
 - c. Melted input wires
 - d. Terminal fusing
- 5) When using a multimeter to set a speaker limiter, what equation do we use to convert wattage and impedance to maximum usable voltage?
- a. $V = WZ$

- b. $V = W/Z$
 - c. $V = Z/W$
 - d. $V = \sqrt{WZ}$
- 6) Which of the following is not generally a reason for adding a delay speaker to a system?
- a. Level of the mains has fallen off too much
 - b. There are permanent mounting positions for delay speakers that are unused
 - c. A physical obstacle has shadowed the HF propagation path of the mains
 - d. The signal from the mains has reached critical distance
- 7) Delay timing for speakers can shift throughout the course of an event. Why?
- a. As speakers get “tired” or “burned in” their time response changes
 - b. As audience moves to the front of the stage for a headliner, less is needed from the delay speakers
 - c. Temperature changes, changing the speed of sound
 - d. All of the above
- 8) If we are using a line array to achieve even SPL coverage over a very deep audience area, which box sets the default maximum level of the array?
- a. The top box
 - b. The middle box
 - c. The bottom box
 - d. Whichever box you choose
- 9) A line array’s boxes are intended to each provide discrete _____ coverage to a particular audience area.
- a. Low frequency
 - b. Mid frequency
 - c. High frequency
 - d. All frequencies

Exercises:

- 1) System tuning is always a good learning experience for students. Before any concert or theater show, installation or other event with a large sound system, engage students in the tuning process. Even a permanently installed system can be retuned before a given production to give the students the experience of doing it. Have different students take the lead at each tuning call, until they feel comfortable leading the work and understanding the process.

CHAPTER 29:

Questions:

- 1) Acoustic absorbers transform acoustic energy into:
- a. Light
 - b. Electricity
 - c. Heat
 - d. Nothing, they destroy the energy
- 2) Standing waves formed in a venue are sometimes referred to as:
- a. Standing modes
 - b. Room modes

- c. Room waves
 - d. Singing note
- 3) The standard term for measuring the reverberance of a venue is:
- a. C80
 - b. Alcons
 - c. STI
 - d. RT60

Exercises:

- 1) Take acoustic measurements of rooms—studio spaces, theaters, etc. Assess basic issues and test solutions (if there is a high frequency buildup at a studio control room mix position, for example, place or build/install simple diffusers on the side walls to break up this buildup). Students often get excited about developing homemade acoustic solutions. Even if their solutions don't work ideally, measuring the results can be a wonderful learning experience regarding acoustics in general. Experiment, test, adjust.

CHAPTER 30:

Questions:

- 1) A sound system designed for one particular event can be described as a _____ system.
- a. Repertory
 - b. Singular
 - c. Production
 - d. Corporate
- 2) Which of the following is NOT typically a question a designer asks when preparing to design a small concert system?
- a. What needs to be amplified?
 - b. Will this show be run in stereo, 5.1, or Dolby Atmos?
 - c. Do we need monitors?
 - d. What type of act is this, and how loud is it expected to be?
- 3) When designing a system for a straight play, which of the following is NOT typically a question a designer needs to ask when preparing?
- a. What kind of sound effects will be played?
 - b. Do actors need mics?
 - c. How loud will the orchestra be?
 - d. Where do the effects need to localize?
- 4) In a theme park, if you are designing a “dark ride”, what kind of attraction is this?
- a. A roller coaster in a dark building
 - b. A water ride run only at night
 - c. A ride with dark narrative themes
 - d. A slow track ride in a closed building
- 5) A repertory system can be defined as:
- a. A venue system to be shared by many different acts or productions
 - b. A touring system

- c. A system that repeats from venue to venue (in corporate settings, where, for example, every Hilton lobby has the same speaker layout)
 - d. A production system with an added recording system
- 6) When assessing content needs for non-narrative and non-musical spaces (e.g. retail and corporate environments), which of the below categories of sound is least likely to be a consideration?
- a. Music
 - b. Announcements/voices
 - c. Sound effects
 - d. Teleconferencing

Exercises:

- 1) Assessing the needs of a project can be a very fruitful exercise for young designers. Choose plays that provide rich sound content (a very, very brief list: straight plays: *Haroun and the Sea of Stories*, *On the Verge*, *Slaughter City*, *The Tempest*, *His Dark Materials*; musicals: *Chicago*, *Rent*, *West Side Story*, *Avenue Q*, this list could literally stretch to eternity), and work through written and/or discussed assessments of the sound needs of the show. As you identify effects, music, and spoken content to be delivered, discuss what kinds of system components and positions might serve these productions.
- 2) This same type of exercise can work well with theoretical concert bills. List a theoretical ensemble (you can start simply, with small folk or rock groups, grow in complexity as the project moves forward), its instruments, and its staging needs. Create a stage plot for the group, and again discuss what kinds of system components and positions might be necessary in order to realize these productions.

CHAPTER 31:

Questions:

- 1) A sound system for an outdoor event or venue must consider some important factors that indoor systems do not need to worry about. Which of the following is a key factor in outdoor system design.
 - a. Using inline versus split consoles
 - b. Weatherizing
 - c. Trunk split isolation
 - d. Transport control downmixing
- 2) A stage with two audience sections, one on each side, facing each other, is often called a:
 - a. Corner stage
 - b. Thrust stage
 - c. Proscenium stage
 - d. Alley stage
- 3) A 360° sound system for a nightclub differs from a regular concert system in several ways. Which of the below is NOT a difference between the two types?
 - a. 360° systems aim to immerse the audience from all directions
 - b. 360° systems don't always have a "front" orientation to the DJ as a concert hall would for a performer

- c. 360° systems don't seek flat response, they always tilt heavily towards bass response
 - d. 360° systems can pose polarity/phase cancellation issues due to speakers facing one another
- 4) The primary sonic difference (concerning the venue itself) between a big-box store and a department store is:
- a. There's no real difference
 - b. Department stores break up into many separate sub-spaces, big-box stores do not
 - c. Big-box stores always need higher SPL than department stores
 - d. Department stores are more concerned with bass response than big-box stores
- 5) When designing in a pre-existing venue, which of the following is the least important question to ask about the venue?
- a. What kind of visual art is hanging on the walls?
 - b. What kind of electrical power is available?
 - c. Where can equipment be safely mounted?
 - d. How large is the venue?

Exercises:

- 1) Present students with hypothetical venues. This can include venues you have technical drawings for (there are a host of online libraries of architectural drawings of buildings and spaces, many theaters and convention centers provide them for free on their websites—or will send them to you if asked), or just imaginary venues you invent. List all the relevant details, then lead an exercise as if you are a client, and the students must ask all relevant questions about the venue, and question any unclear answers, so that it is demonstrated that they understand the information they are gathering and why it is relevant. The more advanced the students, the less info and context you can give them in advance.

CHAPTER 32:

Questions:

- 1) When assessing audience needs, what role does what an audience paid for their tickets play?
- a. It doesn't, that's ridiculous
 - b. It's about audience expectation, those who pay more expect more audio fidelity
 - c. It's about the look of the gear, higher-paying audiences expect to see shinier newer gear
 - d. It determines what class of contract you can demand as a designer
- 2) Audience size is a determiner of several factors of your system. Which of the following is NOT something determined (at least in part) by how large the audience is?
- a. Overall SPL
 - b. Need for delay speakers
 - c. Channel count on mixing console
 - d. Coverage angles needed

Exercises: N/A

CHAPTER 33:

Questions:

- 1) In which of the following system scenarios are you most likely to be renting (rather than purchasing) gear?
 - a. A hotel lobby
 - b. A theme park ride
 - c. A Broadway show
 - d. A concert hall
- 2) When a rental vendor must propose substitutions to the gear you've requested (because they don't have the gear you wanted), which of the following is NOT a possible result?
 - a. You reject the vendor because their substitutions are unacceptable
 - b. You accept the substitutions because they meet your needs as well or better than what you specified
 - c. You accept the substitutions even though they are less than ideal because you can get them at a reduced cost
 - d. You are required by the terms of the quote-issuing process to accept them, regardless of your opinion of them
- 3) True or false: rental prices can often be negotiated
 - a. True
 - b. False
- 4) When quoting prices to clients for a purchased system, we want to list which price point for each item?
 - a. The lowest possible price, it makes you look savvy for getting the best rate
 - b. The average price, it makes you look reasonable and the budget will be fairly realistic
 - c. The MSRP (highest possible) price, as you know you'll be able to buy everything cheaper than you've listed, making you look like a maven in the long run
 - d. Only ever list a real, quoted price that you have in writing as a guaranteed lock
- 5) In order to cut costs, we often sacrifice elements of our designs. Which of the following should NEVER be sacrificed to budgetary concerns?
 - a. SPL delivery
 - b. Safety measures
 - c. Recording systems where applicable
 - d. Flat frequency delivery

Exercises:

- 1) Give students a set of guidelines for a system proposal (e.g. "a system for a rock concert that needs to cover an audience of 10,000, feature 48 mic ins minimum, and reach 110 dB SPL at all locations"). Have them prepare a gear list that would support this proposal, then actually price it out. In some cases, they may have to actually contact vendors for prices on items that aren't publicly listed (speakers and large consoles are notorious for this). Callers should be VERY clear that they are students working on a project, not potential real bidders, but then ask for a loose estimate of cost. Some vendors will bristle at this as a waste of their time, but others will be accommodating and will help students

learn not only how to communicate with vendors about pricing, but give them some grounding in what things actually cost.

- 2) Once students have a rough budget in mind for their system, give each of them a different “value engineering” challenge, something that will limit their system (these are best if they mimic things that might actually happen in a production process, e.g. “an investor has pulled out so we need you to cut 10% from your budget”, “the client has a relationship with a vendor of X speaker company, so you have to change your design to use only those speakers”, and so on). Make them revise their budgets and return to another meeting with the updates. This is a great learning process for encouraging students to not get too attached to their designs, and to help them become familiar with the VE process.

CHAPTER 34:

Questions:

- 1) When considering how loud an event needs to be, if you are not given explicit SPL targets by the producer/promoter/client, how do you know what SPL you need (select all that apply)?
 - a. Measure the SPL of other similar events and keep records
 - b. Consider whether people need to be able to have a conversation in the space while content is playing
 - c. Follow the chart contained in Chapter 16
 - d. Consider whether life-safety is an issue
- 2) What is the *primary* limitation of planning speaker coverage by drawing coverage cones?
 - a. Too many overlapping cones is hard to read
 - b. Cones only apply to directional frequencies, not to LF
 - c. Having to draw the cones takes too much time
 - d. Having to draw both plan and elevation view cones takes too much time
- 3) Which of the following is NOT a typical limitation of speaker manufacturers’ proprietary speaker prediction software?
 - a. Modeling is often 2D, not 3D
 - b. No ability to assign acoustic textures to surfaces
 - c. Graphics aren’t as professional-looking as EASE
 - d. Can’t mix and match speakers from different brands
- 4) A “statistical” speaker prediction model bases its assessment of how sound travels through a venue primarily upon:
 - a. Venue volume, and whether it is open or closed
 - b. Audience density, venue irrelevant
 - c. Speaker performance alone, venue irrelevant
 - d. Assigning every surface a default texture “wood”
- 5) When modeling more than one speaker’s performance at once, it is important to:
 - a. Always model all speakers in your design together
 - b. Model all top speakers together, and all subs together
 - c. Model all speakers carrying the same content together but not speakers carrying different content
 - d. Never model more than one speaker at once, it confuses the software
- 6) Why do we sometimes need front fills in a vocal theater system (select all that apply)?

- a. This isn't a technique we use for vocal systems
 - b. Using only L/R speakers pulls the image away from the actors
 - c. Using only high center speakers pulls the image away from the actors
 - d. Audiences love having small speakers right in front of them
- 7) Why do we model sound effects speaker systems less often than vocal or music systems?
- a. This is untrue, we always model sound effects systems
 - b. It is often evident from speaker selection alone whether our choices will do the needed job
 - c. Sound effects are always a lower production priority than vocals or music
 - d. Sound effects are harder to model because they change so often
- 8) Why would we leave out architectural molding in a venue acoustic model?
- a. We wouldn't, the more detail we include, the more accurate the model
 - b. It just takes too long to add versus value in the model
 - c. It can actively ruin model results due to the way the software weighs objects
 - d. It is acoustically transparent
- 9) Which of the following is NOT a reason we run speaker predictions before we finalize speakers and positions?
- a. It saves money by solving position issues before hiring crew
 - b. It helps us select the proper speakers for the job
 - c. It is easier than drawing coverage cones
 - d. It impresses clients

Exercises:

- 1) Suggest system needs in a default venue, then work through the modeling process to find ideal speaker solutions. Students should work through the whole 10-step process (skipping raytracing and acoustic textures if they are limited to freeware modeling programs). This is a wonderful process, it can be run for different sample systems, and through several iterations. A team can find a great array solution and then be told that the director doesn't want to see arrays, so they need to find the best possible point source solution (for example). This process of changing and refining gets students comfortable with modeling, and thus with speaker selection and planning in general.
- 2) Have students model a very simple system (L/R mains, for example) in a space that matches a venue available on your campus. Then, install that system, and work with the aiming and tuning to see if you can match desired results from the model in the real space. If you can't, examine and refine the model until it can be produced in reality, and figure out why the model was suggesting a performance that was impossible in real life. Conversely, if you still can't match them, figure out what about the real-world situation isn't matching the model. Learning to match reality to a model (and vice-versa) is wonderful grounding in making sure the modeling process does not lead designers too far astray from what is actually possible, since small modeling errors can lead to quite misleading results.

CHAPTER 35:

Questions:

- 1) Which of the following crew positions require human artistry (select all that apply)?

- a. FOH concert engineer
 - b. QLab operator
 - c. Monitor engineer
 - d. RF crew member
- 2) How long is a standard concert soundcheck?
- a. 30 mins
 - b. 60 mins
 - c. 2 hrs
 - d. there is no such thing, each one is different
- 3) A theatrical speaker check involves:
- a. Physically spotting each speaker and visually verifying aim and wiring
 - b. Playing a cue through each speaker and verifying it is properly audible
 - c. Using a multimeter to test signal voltage at each speaker output
 - d. None of the above
- 4) When planning a budget for needed staff, a designer is in the best position if they:
- a. Make the smallest possible budget plan, as it looks good to clients
 - b. Make the largest possible budget plan, as they can definitely cut it down later and look good to clients
 - c. Make a plan slightly larger than they may ultimately need (but very close), to be accurate for clients (with possible savings)
 - d. Make a plan that is only exactly what they believe they will need, to be accurate for clients
- 5) Which of the following system types is least likely to need physical human intervention?
- a. Theater
 - b. Hotel lobby
 - c. Concert
 - d. Theme park ride

Exercises:

- 1) Have students make a staffing plan for a given theoretical production or installation. It can be any type of project, but have them not only think through how many positions they will need, but what their likely work call lengths will be, whether they need multiple shifts, and so on. Then have them present the results to class, and everyone discuss the plans and whether they would work. Can they be made more efficient/affordable? Are there positions that were missed? Are you counting on working people for untenable 16-hr shifts?

CHAPTER 36:

Questions:

- 1) If you've submitted a design to a client, but shortly thereafter you find a better, more efficient way to execute your intent, should you notify your client?
- a. Yes! Every better plan should be presented.
 - b. No! You undermine your authority if you immediately contradict yourself.
 - c. Maybe! If the job hasn't gone to bid yet, and you have a good back-and-forth relationship with the client, go for it!

- d. Yes! Even if gear has been purchased, you can usually return it if its not right!
- 2) Which of the following is NOT a common reason for production budget changes mid-process?
 - a. The producers' available funding streams have changed
 - b. The producers hold a grudge against the sound department and try to shortchange it
 - c. The design proposal goes beyond what the producers believe to be necessary for the project
 - d. The producers decide they want to spend less money
- 3) If your system loses some intended functionality due to budget cuts, do you need to address this with your producers?
 - a. Absolutely, they need to know you won't be delivering what was initially proposed
 - b. Maybe, if they are in a good mood and ready to hear bad news
 - c. No, they won't notice anyway because most producers don't understand sound

Exercises:

- 1) After students have prepared a budget, assign them budget cuts without telling them what to cut. With their new numbers, they then must work through how to meet the new lower budget targets. Present their choices in class, and discuss.

CHAPTER 37:

Questions:

- 1) Which of these common input device types is least likely to be used in a small concert system?
 - a. Wired mics
 - b. Wireless mics
 - c. Surround playback system
 - d. Dis
- 2) True or false: Small concert systems always feature a DSP
 - a. True
 - b. False
- 3) True or false: Small concert systems would never aim main speakers away from the audience
 - a. True
 - b. False
- 4) Which of the following is not a standard designer question when designing a small concert venue?
 - a. Is this system central to the mission of the venue, or a sideline?
 - b. Does this show need to be in quadraphonic surround?
 - c. Does this system need to be packed away and stored at times?
 - d. Does this system handle more than one type of content (e.g. weddings and also small concerts)?

Exercises:

- 1) Have students set up a small concert system, verify and test it, then draft it. Often this makes a great first sound system drawing project. It's much easier for students to draw a system plan and block diagram when they have been involved in the physical setup first.
- 2) Design a sample system! Produce at minimum plan view and block diagram documents, and present/discuss in class.

CHAPTER 38:

Questions:

- 1) Which of the following is NOT a primary difference between the process of designing a small concert system and the process of designing a large concert system?
 - a. DSP planning
 - b. Speaker modeling
 - c. Com system planning
 - d. Mic selection
- 2) A large concert system is often run in mono, why?
 - a. This is incorrect, we have L/R speaker stacks, and run in stereo
 - b. Because stereo on large stages increases feedback risk
 - c. Because wide stages mean something hard panned won't be heard by 1/3 or more of the audience
 - d. Because FOH engineers are lazy
- 3) A term often used for the onstage time of a given musical act is:
 - a. Topline
 - b. Downbeat
 - c. Backline
 - d. Breakdown
- 4) Someone who is in charge of ensuring flown speakers (and other equipment) are safely mounted is called:
 - a. Flyman
 - b. Fly lead
 - c. Rigger
 - d. Trussmaster
- 5) A typical SPL target for a large rock concert in the United States is:
 - a. 90 dB SPL
 - b. 100 dB SPL
 - c. 110 dB SPL
 - d. 120 dB SPL
- 6) Which of the following is NOT a commonly used document in the large concert design process?
 - a. Facility Impact Report
 - b. Block Diagram
 - c. Stage plot
 - d. Rigging Details
- 7) When designers try modeling a line array for the first time, the author recommends that they start with:
 - a. A straight line of boxes with no curvature

- b. A single box at the top of the eventual array
 - c. The top three boxes of the array
 - d. The whole array as you plan to use it
- 8) Why might a designer create coverage that is intended to fall off at the sides of the venue?
- a. They would never do this
 - b. They want the audience to be pulled into the main stage area
 - c. They want to provide a clear area for merch sellers to talk
 - d. They want to avoid shaking the side walls

Exercises:

- 1) Go to a large-scale concert, especially a festival that is standing-room only. Write down all the gear you can identify (and if you can't identify models, at least get counts...e.g. "16 array boxes in j-arrays per side"). Try to draft system documents for the show to the best of your ability when you get home.
- 2) Design a sample system! Produce at minimum plan view and block diagram documents, and present/discuss in class.

CHAPTER 39:

Questions:

- 1) In the production of a straight play, which audio source is generally the highest priority for the audience to hear clearly?
 - a. Music
 - b. Sound Effects
 - c. Ambiences
 - d. Speech
- 2) Which of the following generally presents the biggest challenge in vocal reinforcement for straight plays?
 - a. Localization
 - b. Loudness
 - c. Frequency response
 - d. Polarity
- 3) Which unique digital console feature is designed specifically with theater in mind?
 - a. Scene recall
 - b. Performer profiles
 - c. MIDI message send/receive
 - d. Dimmable console lights
- 4) Which of the following is a challenge in speaker placement for theater that concerts do not generally face?
 - a. Subwoofers can't be put under theatrical stages
 - b. Theaters don't want you to fly speakers
 - c. Theaters want all speakers to be hidden
 - d. Theaters never use delay speakers
- 5) In theater, a "10 out of 12" is:
 - a. A speaker with 10" drivers in a 12" enclosure

- b. A rehearsal day with 10 work hours and 2 hourlong breaks
 - c. A listing of standard audio crew (10 crew, 2 overhire in case of emergency)
 - d. None of the above
- 6) "Tech week" means:
- a. A week where the theater is just technicians, no actors
 - b. A week of technical problems, which everyone wants to avoid (an old theater superstition)
 - c. A week where IT updates the tech in an old theater
 - d. A week of rehearsals with cueing and technical processes given priority

Exercises:

- 1) There is no better exercise than actually designing a show. Many schools put on several straight plays each year, and engaging students (first, perhaps as assistants to faculty, then as lead designers) in the process directly is one of the best learning experiences possible. Straight plays (so long as they have a fair amount of sound effects) engage with a lot of sound system design and technology subdisciplines, and the need of designer control stations during tech week adds another layer of control complexity beyond what is typically found in simple concert systems.
- 3) Barring a whole production: Design a sample system! Produce at minimum plan view and block diagram documents, and present/discuss in class.

CHAPTER 40:

Questions:

- 1) An A/B system can mean which of the following (select all that apply)?
 - a. A system with separate signal paths to different speakers for vocals and music respectively
 - b. A system with a toggle switch to easily swap a signal from one spot to another in the venue
 - c. A system where two actor mics will be routed to two separate speakers to avoid cancellation in the summing electronics
 - d. A system with two main coverage options, the first of which (A) the designer prefers, and the second of which (B) is in case the director doesn't like (A)
- 2) The first rehearsal in the theater with both actors and orchestra is referred to as:
 - a. Orchestra seating
 - b. Sitzprobe
 - c. Wandelprobe
 - d. First tech
- 3) Orchestra musicians in Broadway-style musicals usually hear foldback via:
 - a. A dedicated monitor console feeding wedges in the pit
 - b. A dedicated monitor console feeding wireless in-ears
 - c. Personal mixing stations fed from FOH
 - d. There is no foldback in Broadway-style orchestras

Exercises:

- 1) Again, designing a musical is a great practical project, if your school or organization produces them.
- 2) Barring a whole production: Design a sample system! Produce at minimum plan view and block diagram documents, and present/discuss in class.

CHAPTER 41:

Questions:

- 1) True or false: Convention center sound systems always feature venue-wide paging audio systems for emergency announcements
 - a. True
 - b. False
- 2) Temporary partitions between meeting rooms in convention centers (or hotels hosting convention-style events) are referred to as:
 - a. Accordion walls
 - b. Air walls
 - c. Paper walls
 - d. Fake walls

Exercises: N/A

CHAPTER 42:

Questions:

- 1) Which of the following is NOT typically a consideration when designing systems for new performing arts venues and houses of worship?
 - a. Intended life span of system
 - b. Expendable schedule
 - c. Historical landmark status
 - d. Range of events to be hosted
- 2) The term for musical instruments and equipment that might be part of a music venue's permanent stock is:
 - a. Instruments and equipment
 - b. Music stock
 - c. Backstock
 - d. Backline
- 3) True or false: Most contemporary performance venues have some built-in provision for recording performances
 - a. True
 - b. False
- 4) A plan view drawing that only shows items mounted overhead (as opposed to on the floor) is called:
 - a. A bird's eye plan
 - b. A plan view (no special name)
 - c. A loge plan
 - d. A reflected ceiling plan

- 5) In houses of worship, the area holding the pews or seats is often referred to as:
 - a. The audience
 - b. The pit
 - c. The nave
 - d. The pulpit
- 6) A type of technical documentation platform that allows for 3D modeling of not just a venue's structure, but HVAC, electrical, plumbing, and other systems, is called:
 - a. Detailed 3D stack
 - b. Building information modeling
 - c. Building energy flow modeling
 - d. Closed confines prediction
- 7) The initial design phase on large installation projects is sometimes referred to as:
 - a. SD-schematic design phase
 - b. DD-detail design phase
 - c. CD-concept design phase
 - d. CP-clearview planning phase
- 8) On a large installation project, who is the first person or group a system designer will present their work to?
 - a. The client
 - b. The architect
 - c. The AV integrator
 - d. Whoever hired you directly

Exercises:

- 1) Download raw plans for a venue from one of the many free CAD libraries online (I won't recommend any specific one here, as I don't want to be perceived to be endorsing any business, but Googling "free architectural CAD drawings" or the like usually turns up decent results). Create a plan for what the venue will be producing, and then lead students through a term-long design project for this venue.

CHAPTER 43:

Questions:

- 1) What is a common SPL target for a sound system in a clothing store?
 - a. 85 dB SPL
 - b. 100 dB SPL
 - c. 70 dB SPL
 - d. Depends on the type of store, clientele, etc.
- 2) Which of the following is NOT a typical acoustic challenge presented by big-box stores?
 - a. No drop ceilings
 - b. Non-absorptive floors
 - c. Flat reflective walls with nothing to break up standing waves
 - d. Cavernous reverb time
- 3) A speaker mounted overhead in a big-box store is often mounted in what way?
 - a. Hung from its signal cable
 - b. Steel poles welded to support beams or ceiling itself

- c. C-clamps/pipe
 - d. None of the above
- 4) Which of the following is the biggest difference between shopping mall sound systems and airport sound systems?
- a. Airports are louder
 - b. Malls are louder
 - c. Airports are higher-fidelity because they are more expensive to enter
 - d. Security/access control
- 5) A retail term for “groundplan” is:
- a. Groundplan, it’s the same term
 - b. Planogram
 - c. Buyplot
 - d. Shoplot

Exercises:

- 1) Go to a variety of retail spaces, and examine their sound systems. You won’t be able to see back of house equipment (though if you ask a manager nicely, explaining that they are doing a school project, they might let you), but you can at least get a good sense of speakers and coverage. Note if there are dead zones where audio coverage is poor, or hot spots, or other undesirable features.
- 2) Download raw plans for a retail space from one of the many free CAD libraries online (I won’t recommend any specific one here, as I don’t want to be perceived to be endorsing any business, but Googling “free architectural CAD drawings” or the like usually turns up decent results). Lead students through a term-long design project for this venue.

CHAPTER 44:

Questions:

- 1) Which of the following is NOT a themed environment (typically)?
 - a. Amusement parks
 - b. Casinos
 - c. Corporate headquarters
 - d. Cruise ships
- 2) Which part of a themed environment’s sound system is most critical to design with redundancy?
 - a. Playback of main BGM
 - b. Life-safety systems
 - c. Operator com systems
 - d. Foreground effects systems
- 3) While a mixing console can be said to be the “heart” of a concert sound system, what is the “heart” of a theme park ride’s system?
 - a. There isn’t one
 - b. The mixing console
 - c. The speakers
 - d. The DSP/playback server

- 4) Parade floats might be tracked in real time by which of the following devices (select all that apply)?
 - a. Entry sensors along the parade route
 - b. RFID tags on the floats
 - c. GPS transmitters on the floats
 - d. SPL sensors to read the noise of each vehicle as it approaches
- 5) A teacup ride is which category of attraction?
 - a. Dark ride
 - b. Flat ride
 - c. Thrill ride
 - d. Motion simulator ride
- 6) A name for non-ride, non-shop open areas of an amusement park is:
 - a. Sidewalks
 - b. Meet 'n' greet areas
 - c. Area development
 - d. Walk-thrus
- 7) Which of the following is NOT a typical venue challenge for cruise ship systems?
 - a. Water-resistance
 - b. Reliability (hard to get parts at sea)
 - c. Magnetic polarity of devices thrown off by large coils in ship engines
 - d. Life-safety override of all systems
- 8) A door that separates one dark ride scene from another is often called a:
 - a. Door
 - b. Dark door
 - c. Push door
 - d. Bump door
- 9) A room that houses racks of equipment that no one has to interact with as part of operations, in a theme park, is often called:
 - a. Machine room
 - b. Rack room
 - c. Electronic equipment room
 - d. Control room
- 10) A patch panel permanently installed in a themed environment to provide connections to (for example) speakers, is called:
 - a. Patch panel
 - b. J-box
 - c. PP
 - d. PPM
- 11) The space around a ride car that needs to remain clear to ensure no rider will be struck by equipment is called:
 - a. Ride envelope
 - b. Car clearance
 - c. Tunnel width
 - d. Grant zone
- 12) A "rock speaker" is:
 - a. A speaker designed to reproduce rock music
 - b. A speaker enclosure carved out of rock
 - c. A speaker enclosure designed to look like a rock

- d. A speaker hidden in rocks
- 13) Which of the following is NOT a standard part of a themed entertainment document package?
- a. Block diagram
 - b. Equipment schedule
 - c. Call sheet
 - d. FIR

Exercises:

- 1) This is one of the hardest parts of our business to train for as a student. There are no stock designs you can get for free, trade secrets are hoarded and subject to non-disclosure agreements, and people are very tight-lipped about how they designed things. One of the better ways to get acquainted with the industry is to get an internship with a firm that does this work. Another is to attend the annual IAAPA (International Association of Amusement Parks and Attractions) conferences and events, as you can meet a lot of industry people and see a lot of technology there. If you happen to be part of a school that also has an industrial automation program (or hardcore mechanical engineering, or something similar) you might be able to persuade them to start up a pilot project on a simple motion-simulator platform that would allow students to coordinate audio with machine data, but this is a far stretch, and tough to pull off on most schools' budgets. There is now one graduate program in themed design (at CalArts). You can study there...

CHAPTER 45:

Questions:

- 1) Which of the following is often necessary in a music studio, but would not be necessary in a concert venue?
- a. DAW/recording system
 - b. Talkback from engineers to performers
 - c. Excellent acoustic design of the room
 - d. Multiple sets of speakers to compare a mix in
- 2) A device with faders and knobs, used to control sound, that passes no audio through it, is often called a:
- a. Mixing console
 - b. Control surface
 - c. Dummy mixer
 - d. Silent mixer
- 3) A room that houses racks of equipment that make noise that would be undesirable in the control room is often called:
- a. Electronic equipment room
 - b. Amp room
 - c. Machine room
 - d. Server room
- 4) A method of mounting large monitor speakers into walls is called:
- a. Inset

- b. Floated
 - c. Planar
 - d. Soffit
- 5) TDM stands for
- a. Time division multiplexing
 - b. Time division multitracking
 - c. Text display multimonitor
 - d. Test demo meter
- 6) A mixing console with two rows of faders, one row controlling signal to a recorder, one row controlling playback from that recorder, is called:
- a. Split console
 - b. Dual-fader console
 - c. Inline console
 - d. Tiered console
- 7) A small room used for vocal recording or the like is sometimes called:
- a. Iso booth
 - b. Flood booth
 - c. Closet
 - d. Death trap

Exercises:

- 1) If you live in a region where there are professional recording studios, try to arrange a studio tour (if you can find a time when they are not busy, studios will sometimes arrange an intern to give you a tour). Note all the equipment, ask questions about signal flow, operations staff, etc.
- 2) Plan a fictional recording studio from scratch, create documents, have design meetings, evaluate needs, etc.

CHAPTER 46

Questions:

- 1) True or False: Sometimes we need to add noise to an office environment because it is too quiet
 - a. True
 - b. False
- 2) Is high fidelity a high priority in most corporate office sound systems?
 - a. Yes, it is always a high priority for sound system designers
 - b. Most of the time, but in rare cases it is not
 - c. Ha! No

Exercises: N/A

CHAPTER 47:

Questions:

- 1) What is a typical time frame for a fine art sound system project?
 - a. 6 months
 - b. 1 year
 - c. no such thing
 - d. 6 weeks

Exercises:

- 1) Create a sound art piece! Be creative! Use systems and technologies in weird unconventional ways! Work with interactivity! The sky is the limit!

CHAPTER 48:

Questions:

- 1) A drawing label that identifies the name of the project and designer, the name and number of the particular drawing plate, the revision #, and other information is called:
 - a. Label
 - b. Title block
 - c. Legend
 - d. Key
- 2) A visual key to symbols used in a drawing set is called:
 - a. Title block
 - b. Rubric
 - c. Legend
 - d. Plate index
- 3) Text in drafted technical drawings should always:
 - a. Be written in cursive
 - b. Be written in that one font that looks like the old hand-drafting lettering standard
 - c. Be written in complete sentences
 - d. Be written in all caps
- 4) Lineweights are used to (select all that apply):
 - a. Distinguish one type of item from another
 - b. Distinguish items in one position from items in another
 - c. Show literal thickness of an object
 - d. Tell a build crew which items are likeliest to get cut from the design
- 5) Drawing layers are used to (select all that apply):
 - a. Sort items of one type from items of another type
 - b. Make it easy to turn off labels and text and just look at items
 - c. Keep expensive gear in one layer and inexpensive gear in another
 - d. Help departments overlay designs and check for errors
- 6) Which of the following are problems with using color-coding in technical drawings (select all that apply)?
 - a. Some people are colorblind, and if info isn't show another way it is lost to them
 - b. Color drawing isn't the standard, and isn't accepted at most production shops
 - c. Color ink is expensive and if drawings are printed they will normally be printed in black and white

- d. Some colors that show up against a black screen disappear against a white page in layout views
- 7) When emailing CAD drawings of any type/brand, best practices dictate that you compress the files (usually as a .zip archive). Why?
- a. Because it makes them easier to name
 - b. No technical reason, it's just industry standard
 - c. Because CAD files corrupt when emailed on their own sometimes
 - d. Because it makes them easier to open with any drafting software

Exercises:

- 1) Every project could use technical documentation. Start simply—build the smallest possible test sound system (a mixer, a mic, powered computer speakers) and have students draft a block diagram, plan view, and write a hookup. Build up in complexity, step by step, from there. All of the previous system exercises listed for chapters of this book can use technical drawings, and all of them should be reviewed not just for the design but the drawings as well—are they drawn to scale, to USITT (or other) standards/recommendations? Are they clear and easy to read? Is the text large enough without being too large? I like to give students a couple of system drafting projects where the design isn't being judged, just the drawing, so they can focus on documentation, but then I give them merged projects where it is all being evaluated.

CHAPTER 49:

Questions:

- 1) An elevation view shows a venue from the side, front, or rear. What indication on a plan view drawing tells us which view we will see in an indicated elevation?
- a. Elevation callout
 - b. Slice line
 - c. Cutting plane
 - d. None, elevations are wholly independent of plan views
- 2) From which theatrical discipline do our basic drafting standards of lineweight and type derive from?
- a. Costuming
 - b. Scenery
 - c. Video
 - d. Lighting
- 3) Which theatrical discipline came first?
- a. Lighting design
 - b. Sound design
 - c. Video design
- 4) When drafting a speaker plot, it is assumed that we will use 100% accurate representations of the size/shape of our speakers. Why is this the case (select all that apply)?
- a. Because manufacturers issue accurate CAD models of their devices, so it's very easy to do so

- b. Because we have become pickier in how we visually represent data in the computer age
 - c. Because space for hanging items in a venue is decreasing due to demands by lighting, video, and sound teams, so drawings must be true to life
 - d. Because it looks cooler
- 5) What is a commonly overlooked item that sound designers need to make sure to include in their drafting?
- a. Speaker cables
 - b. Fly hardware
 - c. Humans for scale reference
 - d. None of the above
- 6) How do we typically show scenery underneath our sound items on a plan view drawing?
- a. Yellow, as it is very light and thus does not interfere with our sound objects
 - b. Dashed, to indicate that they are not sound objects
 - c. Greyed out, to make sound objects easier to see
 - d. All of the above
- 7) Trim height generally refers to:
- a. The distance between a speaker's rigging point and a stage deck
 - b. The distance between a speaker's bottom edge and a stage deck
 - c. The distance between a speaker's rigging point and the next nearest flooring (scenic platform, lift, whatever)
 - d. Any of the above, so long as it is noted in your legend
- 8) When numbering a L/R pair of point source speakers in a plot, the Left speaker should be:
- a. Any number you like
 - b. An odd number
 - c. An odd number paired directly with the next integer up, which is the number of the Right speaker
 - d. None of the above
- 9) A drawing that assesses what will be in view of any given audience member (and, as such, what might obstruct their view) is called:
- a. View study
 - b. Audience angle plot
 - c. Site survey
 - d. Sightline study
- 10) Rack elevations show what gear is rack mounted, in what positions. When we number rack spaces on a drawing, should space #1 be at the bottom or top of the rack?
- a. Bottom
 - b. Top
 - c. Either, so long as you are consistent through the project

Exercises:

- 1) Give students the details of a system to be drawn. Specify everything for them, speaker counts, types, positions, etc. Have them draft said system in plan and elevation views. Review their drawings for accuracy, consistency between plates, etc.

CHAPTER 50:

Questions:

- 1) A given piece of equipment is represented in an SBD as a rectangle with model, unit #, and connection info shown on it. This graphical object is referred to as:
 - a. Nothing, it's called by the type of device (“amp”, “mixer”, etc.)
 - b. Device block
 - c. Device object
 - d. Write block
- 2) A small arc in a signal line, used at the intersection of two signal lines in an SBD to indicate that those signals do not interact at the system level, is called:
 - a. Loop line
 - b. Arc jump
 - c. Jump line
 - d. Bump intersect
- 3) When a device is shown in more than one place in an SBD set, convention dictates that we do what to indicate this?
 - a. Use a note
 - b. Dash the outline of the device
 - c. Use a very thick lineweight for the outline of the device
 - d. Draw a break line as the bottom edge of the device block
- 4) Which part of a system should always be shown on separate SBD plates from the main system interconnects?
 - a. Power system connections
 - b. Network connections
 - c. Analog vs digital audio connections
 - d. None of the above

Exercises:

- 1) Much like the exercise for Chapter 49, give students a system with all technical details provided, and then task them with drawing it. These exercises work best when these systems can then be installed and tested, so they have practical hands-on experience with the gear rather than a purely on-paper abstract sense of the setup, but even a paper project can be good training for technical drawing. In the review of the project, make sure everything is clear, and technically correct.

CHAPTER 51:

Questions:

- 1) Which of the following is NOT a reason to take on the task of drawing mounting details for sound equipment?
 - a. Because you've specified a line array, and the splay and pick point details are things you need to plan
 - b. Because you are mounting something in a custom position with acoustic performance requirements, and the scenery team doesn't understand the sonics enough to properly design the mounting

- c. Because you really want to draw them, whether you are a qualified mounting designer or not
- d. Because you are on an architectural project that requires drawings of even stock mounting solutions

Exercises:

- 1) Have students prepare two mounting drawings” one for a conventional line array, using manufacturer-provided tools to detail splay and rigging points, weight distribution, etc.; the other showing a custom mount of a setup you determine in advance (e.g. a driver mounted into a stove prop, or something of equally custom but generally simple nature). Review the solutions for feasibility and clarity of intent communicated by the drawing.

CHAPTER 52:

Questions:

- 1) Which disciplinary field within sound design is most likely to use magic sheets?
 - a. Corporate HQs
 - b. Theater
 - c. Concerts
 - d. Theme parks

Exercises:

- 1) Have students prepare a usable magic sheet based on an already-extant system block diagram and plan (ideally, one they have drawn, and even more ideally, one for an actual theatrical production you are mounting). Review the document for clarity and ease of use in a darkened theater during tech rehearsals.

CHAPTER 53:

Questions:

- 1) The difference between a simple hookup and a routing table is:
 - a. Nothing, they are two names for the same document
 - b. A hookup shows everything in a system, a routing table shows one piece of equipment only
 - c. A hookup shows physical connections, a routing table shows digital signal flow setup interior to a device
 - d. A routing table shows physical connections, a hookup shows digital signal flow setup interior to a device

Exercises:

- 1) Have students generate a simple system hookup for a very basic analog system, then progress to larger hookups and routing tables for larger systems (either from sample

systems you have generated from earlier exercises based on this book, or ideally from real systems you will build—or have already built).

CHAPTER 54:

Questions:

- 1) “CFCI” on an equipment schedule means:
 - a. Call first, close install
 - b. Contractor-furnished, contractor-installed
 - c. Contractor first, contractor inserted
 - d. Contractor finished, contractor instantiated
- 2) A cable schedule for a concert tour might show _____ differently from a cable schedule for an architectural installation project?
 - a. Cable length
 - b. Cable type
 - c. Nothing, they are totally the same document
 - d. Everything, there are too many differences to list here
- 3) On what type of project is an FIR least likely to be generated?
 - a. Architectural installation
 - b. Theme park attraction
 - c. Concert tour
 - d. Theatrical production

Exercises:

- 1) Have students generate cable and equipment schedules for simple real-world (or paper-project, if no real-world system can be created) systems they have designed. Check documents for accuracy and clarity.
- 2) Have students generate FIRs for the fictional architectural projects suggested in previous chapters. Check for accuracy and clarity.

CHAPTER 55:

Questions:

- 1) When preparing budget paperwork, we might separate gear by (select all that may apply):
 - a. Category of equipment
 - b. Location in a venue
 - c. Manufacturer
 - d. Color

Exercises:

- 1) Students have generated project budgets based on the earlier budgeting chapter. Check their paperwork for efficient and clear communication.

CHAPTER 56:

Questions:

- 1) A technical narrative document is a useful tool for designers, but is primarily intended for what audience?
 - a. Engineers
 - b. Integrators
 - c. Clients
 - d. Architects

Exercises:

- 1) Prepare a fictional project creative narrative. Present it to students and have them write a technical narrative reflecting the project. Assess documents not only for clarity, but for appropriate balance between describing the technical and leaving out truly technical terms of art.

CHAPTER 57:

Questions:

- 1) Which of the following technical documents does a bidding integrator generally never need to see?
 - a. Plan view
 - b. SBD
 - c. Technical narrative
 - d. Rack elevations

Exercises:

- 1) Have students assemble all the sample documents they have prepared for a given project (whether an imagined “paper-only” project, or even better a real system they have worked on). Review the packages for coherence, logical order of documents, consistency of labeling, fonts, title blocks, legends, language used, etc.

CHAPTER 58:

Questions:

- 1) What is one advantage of virtual presentations compared with in-person presentations?
 - a. They require less explanation
 - b. Your breath doesn't have to be fresh
 - c. You don't have to be as energetic
 - d. You can tell more jokes

Exercises:

- 1) Have students go through first presentations for a given design proposal (anything, for a system real or imagined). For two different designs, do one virtual and one in-person presentation. Act as a supervisor or client, and put them through the paces.

CHAPTER 59:

Questions:

- 1) A red cloud drawn around an area of a document that is in question is called:
 - a. A red cloud
 - b. An error cloud
 - c. A question cloud
 - d. A revision cloud

Exercises:

- 1) After students present a first pass at a design, assign them changes or questions to answer, and have them present their revisions. Evaluate on clarity of design thinking as well as skill in presenting their new solutions.

CHAPTER 60:

Questions:

- 1) What does it mean to have “signed off” on a design?
 - a. You put your signature at the bottom of a package, indicating you approve the contents
 - b. You assert that the design is complete and should be executed as indicated in your drawings
 - c. You sign your designer contract for payment
 - d. None of the above

Exercises: N/A