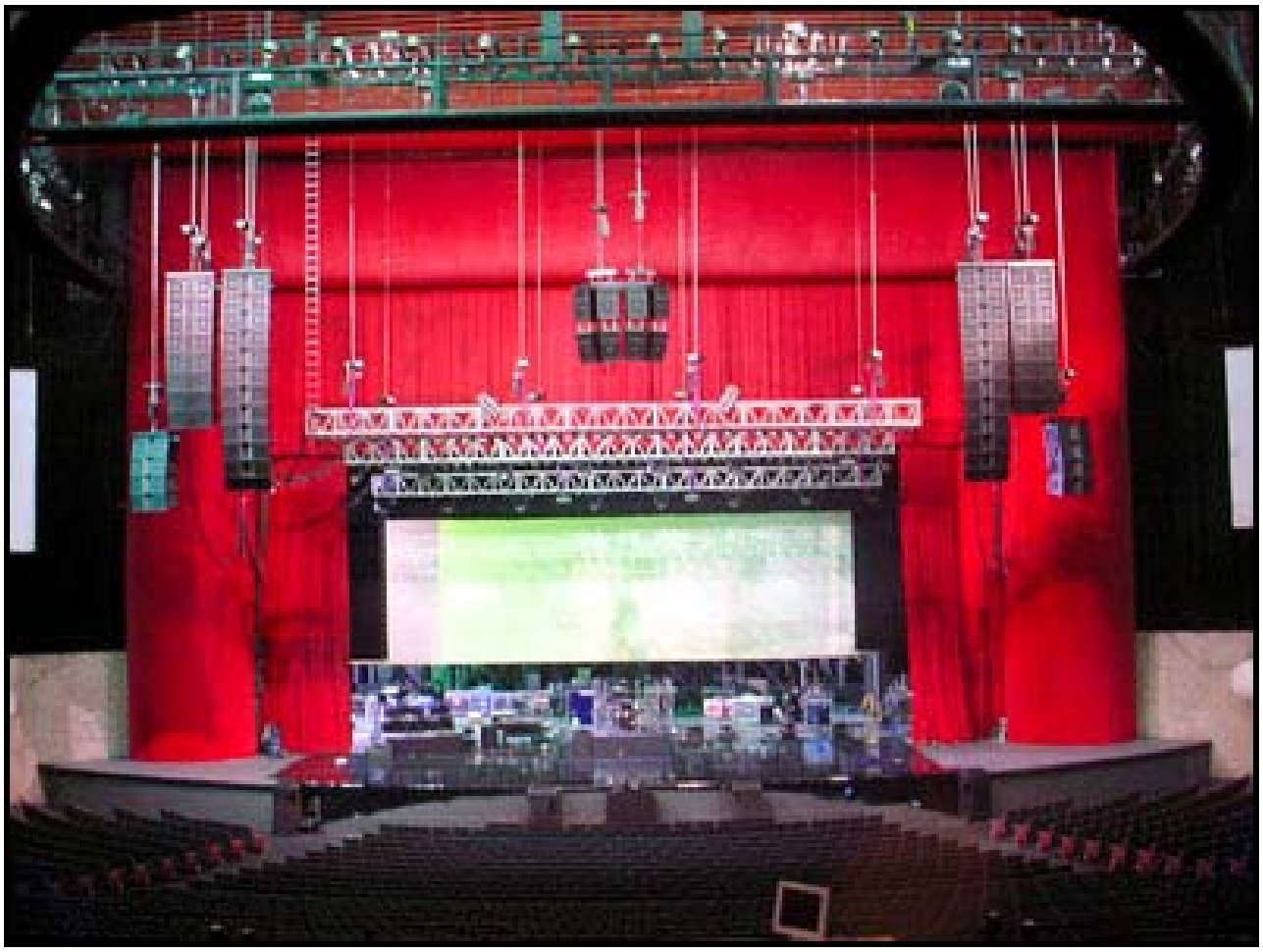
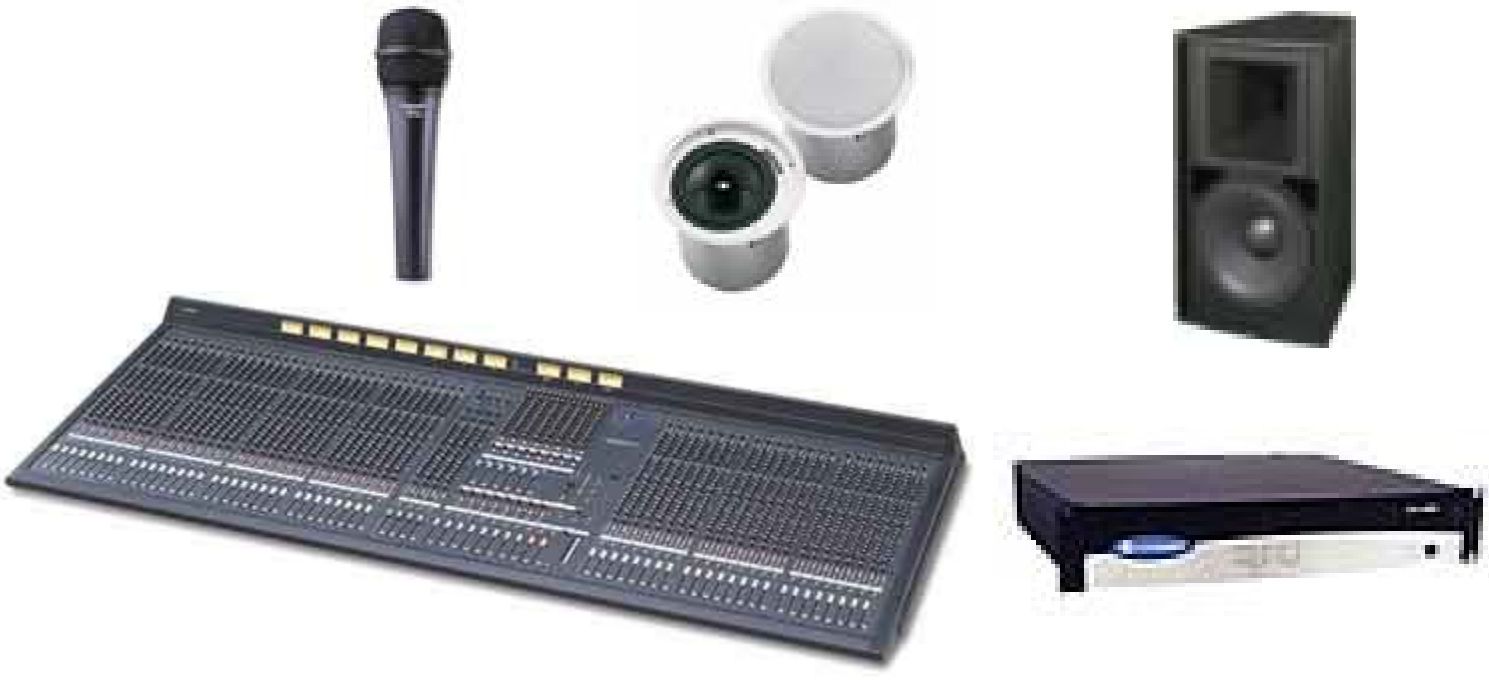
ECE 40020 – Sound Reinforcement System Design

Course Syllabus – Updated 4/28/2020





Course Description: An introduction to computational tools used in the measurement and analysis of electro-acoustic systems, and their application to sound reinforcement system engineering. Two design projects provide the context for application of sound reinforcement system design principles and practices.

Course web site: https://engineering.purdue.edu/ece40020

Instructor: Prof. David G. Meyer, meyer@purdue.edu, Phone: 765-494-3476. Effective 3/23/2020, office hours will conducted on Thursdays, 3:00-5:00 pm EST, via WebEx: https://purdue.webex.com/meet/meyer (meeting room is 617 607 489).

Required Text: *Sound Systems: Design and Optimization –3rd Ed.*, Bob McCarthy, Focal Press, ISBN 978-0415731010.

Required: Standard 5-button iClicker

Reference: *Sound System Engineering – 3rd Edition*, Don Davis and Eugene Patronis, Focal Press, 2006, ISBN 978-0-240-80830-7

Prerequisite: ECE 255 or consent of instructor

Pre- or Co-requisite: ECE 301 or consent of instructor

Prerequisites by topic: Basic electronic components and circuit design principles

Co-requisites by topic: Basic understanding of signals and systems

Loudspeaker Design Project: Working in teams, students will design a compact full-range "stereo" loudspeaker system. It will have a built-in Bluetooth interface, signal processing, and class-D power amplifier. It will employ a total of 3 drivers: a single "woofer" for summed left+right signals below 200 Hz, and separate "midrange/tweeters" for each channel that operate at frequencies above 200 Hz. Each team will ~~present their results to the class and~~ submit a final written report documenting their design.

Sound Reinforcement Design Project: Working in teams, students will design a complete sound reinforcement system for a specified application, including: simulation of loudspeaker coverage; determination of fill and delay zones (if required); ~~estimation of gain before feedback and system intelligibility~~; power amplifier choice based on headroom, SPL, and zone-related requirements; specification of the signal processing chain (including EQ, delay, and feedback suppression); design/layout of the equipment rack(s); choice of mixing console based on I/O specifications; selection of microphones (both wired and wireless); and total system cost estimate. Each team will ~~present their results to the class and~~ submit a final written report documenting their design.

Engineering Design Content: Elements of the engineering design process addressed in this course include testing, measurement, analysis, and synthesis.

Engineering Design Considerations: The primary engineering design considerations addressed in this course include economic, safety, reliability, social, and ethical.

Class Attendance: ***Attendance at all class meetings is required. You must be present to earn credit for class participation exercises using iClickers – no exceptions will be made.***

Tentative Course Outline:

Week(s)	*Lecture Topics*
1-4	Sound systems: transmission, summation, reception, evaluation
5	Exam 1
5-9	Design: prediction, variation, combination, cancellation, specification
~~10~~	~~Exam 2~~
~~11~~10-13	Optimization: examination, verification, calibration, application
14-15	Equipment selection for ~~EASE~~ sound system project: loudspeakers, power amplifiers, signal processing, mixing consoles, microphones, racks, cabling
16	~~Project Presentations and Loudspeaker Soundoff™ Competition~~ ~~Exam 2~~

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

i. an ability to apply engineering design to create a product that meets the specified needs of this engineering design experience with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

ii. an ability to develop and conduct experimentation, analyze and interpret data, and use engineering judgment to draw conclusions related to the development of the product of this engineering design experience.

iii. an ability to identify, formulate, and solve complex engineering problems arising from this engineering design experience by applying principles of engineering, science, and mathematics.

iv. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives associated with this design experience.

v. an ability to communicate effectively with a range of audiences appropriate to this design experience in both a written report and oral presentation.

vi. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies to complete the engineering design experience associated with this course.

vii. an ability to recognize ethical and professional responsibilities associated with this engineering design experience and make informed judgments which must consider the impact of the product of this engineering design experience in global, economic, environmental, and societal contexts.

You will receive 0.5% bonus credit for each course outcome that is successfully demonstrated. The threshold for successfully demonstrating each course outcome is 60% (if multiple evaluation instruments are used for a given outcome, this threshold can be achieved based on the average of each set). The following instruments will be used to assess course outcome demonstration:

Outcome	*Evaluation Instrument(s) Used*
(i)	Design Constraint Analysis score on EASE Focus Sound System Project Report
(ii)	Results score on Loudspeaker Project Report
(iii)	Design Narrative score on Loudspeaker Project Report
(iv)	Design Constraint Satisfaction score on EASE Focus Sound System Project Report
(v)	Writing style/professionalism scores on project reports ~~and presentation~~
(vi)	Hourly exam~~s~~ (over course text and supplemental notes)
(vii)	Engineering Design Process score on EASE Focus Sound System Project Report

Course Grade:
Your grade for this course will be based on the following:

- Loudspeaker Design Project
  - Report (team – ~~15~~ 25%) **NEW DUE DATE IS 5/1/2020**
  - Finished system performance/integration/workmanship (~~team~~ individual bonus – 10%)
- Sound Reinforcement System Design Project
  - Report (team – ~~15~~ 25%) **NEW DUE DATE IS 5/6/2020**
  - ~~Formal presentation (team – 10%)~~
- Exams
  - Exam 1 (individual – ~~15~~ 25%)
  - ~~**Exam 2 (individual – 15%) *note: will be open book, free response***~~ ***NO FINAL***
- Lab / Homework Exercises (~~20~~ 25%) *note: "lab" homework replaced by "lecture" homework for "virtualized" half of semester (relative weights of individual homework/lab exercises will vary based on difficulty/length)*
- Outcome Demonstration Bonus (individual – up to 3.5%)
- Individual bonus credit earned on BHW #1 and BHW #2 will be added to your point total

Borderline Cases: A "borderline" is officially defined as being within 0.5% of a cutoff when the final grade calculation is performed. Before course grades are assigned, the instructor will carefully examine all such cases and determine if the next higher grade is warranted. A special bonus, IDPPB (*Instructor Discretion Posi-Points Bonus*), will be used to facilitate borderline adjustments; ***note, however, that the "next higher grade" is NOT automatically guaranteed.***

Incompletes and Conditional Failures: A grade of "I" or "E" will be given *only* for cases in which there are ***documented*** medical or family emergencies that prevent a student from completing required course work by the end of the semester. Note that University Regulations stipulate that a student must be passing in order to ***qualify*** for a grade of "I" or "E".

Campus Emergencies: In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Should such an emergency occur, information will be posted on the course web site Message Board. *Syllabus may be subject to further updates based on developing conditions.*

Professionalism and Academic Honesty: The temptation to cheat is particularly prevalent in large enrollment courses such as this one. In the long run, *short-cuts in school work* breed *short-cuts in careers*, i.e., the less you invest in your education, the less you will have to show for it later in life. A large part of the educational process is simply developing the *discipline* and *mindset* required to contribute in a given technical area once you graduate. If for nothing other than your own benefit, *do not copy the work of any other student* (past or present). Further, be advised that any *documented* case of "cheating" will result in a **FAILING GRADE** for the course as well as possible disciplinary action. All cases of academic dishonesty will be reported to the ECE Associate Head as well as to the Dean of Students. ***A professional person does not take credit for the work of someone else.***

Examples of Cheating: Contrary to the beliefs of the post-modern "situational ethics" crowd, there are indeed absolutes that apply to integrity and honesty. Examples of activities that will be construed to be "cheating" include **(but are not limited to)** the following:

- copying the work of another student (past or present) and representing that work as your own
- obtaining information about an exam prior to taking it
- having someone else take an exam for you
- bringing "cheat sheets" in any shape/form with you to an exam
- using a cell phone or other electronic device to share information during an exam
- using a pen camera, cell phone, or any other device to photograph exam materials
- modifying a graded homework paper and submitting it for reevaluation
- sharing homework solutions with other students
- using another student's (past or present) homework files
- using an iClicker that belongs to someone else to "fake" their class attendance
- copying and/or redistributing any of the copyrighted materials posted on the course web site
- publically posting solutions to homework problems

Mediocrity: One of the biggest problems facing our educational system today is mediocrity – too many students want to learn merely (often *barely*) enough to "get by". In fact, higher education is probably the only "commodity" from which consumers want to get the *least* amount for their money! Clearly, if our country is to be competitive in an expanding world market, a renewed commitment to excellence is absolutely essential. To quote C. R. Swindoll, "The greatest waste of natural resources is the number of people who never achieve their potential."