Objective
The objective of this experiment is to give the student experience in designing simple amplifier circuits and to experience the effects of “real world” components on theoretical designs.

Equipment Requirements

Oscilloscope
Operational Amplifier (Bench Stock) LM 356, 358, 386, 741
Electret microphone: (Bench Stock) WM-60PC 12V .5ma, 54db, 2.2k, 20 – 12kHz or equivalent
Speaker 2.2” 400 - 4kHz (Bench Stock)
Transistor Output Optoisolator H11A1 (Bench Stock)
Passive components (Component Kit + Bench Stock)
Power supply
Multimeter
Function Generator

Design Problem

This project is really three projects in one. Your instructor will divide the class into groups and each group will perform one of the tasks. All groups will produce a single report and a single presentation. All members of the group must participate in the presentation. The report and presentation will be assessed using the standard report and presentation rubrics. In addition, each group will fill out a peer assessment form to assist the TA in evaluating individual performance.

Task 1
Design, simulate, construct, and test and demonstrate a circuit that displays the following characteristics: You will be provided an electret microphone. Design an amplifier to connect it to an 8 Ohm speaker in such a fashion that a human voice is amplified. The amount of amplification must be variable and audible. There must be less than 1% THD at 2 kHz.

Task 2
You will be given a 10 K Ohm potentiometer. Given a 9 V dc input, use the potentiometer as a voltage divider to produce a +1 V dc output. That +1 V dc output will be applied to an amplifier powered only by a 9 V dc voltage source with a voltage gain $A_v = -2.5$. The input voltage must remain stable at $1V \pm 5mV$ after connection to the amplifier.

Task 3
EE 3306 Amplifier Design

Given an 8 Ohm speaker to use a microphone input device, design an amplifier that will enable you to drive another 8 Ohm speaker.

**Task 4**

Given 0 – 5V, 20 kHz, square wave input, produce an output signal, into a 2.2k Ohm load of +10V when the input is +5V, and -10V when the input is 0V. Provide at least 1000V of isolation between the input and the output signals. A ±15V power supply may be used.

**Deliverables**

The research and design phase of this project will begin immediately. Circuit design and P-Spice simulation will be accomplished during the first week of the project. The **functional circuit** must be ready for performance tests at the beginning of the second week. The **system design report** will be due one week after the performance testing concludes. Thorough documentation is vital to the success of this project. Each design team will be required to deliver a **15 minute presentation** describing their project, design and results. There will be a 5 minute question and answer session following your presentation. Be prepared to answer questions and justify decisions regarding your design.

Your documentation must present a thorough mathematical description of the system and its predicted behavior. You may use computer simulations to augment your design efforts but they can not be used to replace a thorough understanding of the circuit. Verify the functionality of your design by comparing the predicted values to the circuit’s observed behavior and the system specifications. Explain any discrepancies.

**Resources**

You should be able construct your design with the basic components that have been given to you in your component kit and the bench stock in your lab. Your design may require other resistance, capacitance, or inductance values. If so, request them through your TA. Your TA will vet all component requests and will be the only point of contact to the component supplies under Mr. Miller’s control. Most standard values for resistors and capacitors are readily available. Inductors however, may require some resourcefulness on the part of the designer.

**Guidance**

There are a wide variety of approaches to this design problem. You may choose to create your amplifier using a discrete device or devices, or an integrated circuit like the 741 Op Amp. Be aware that each task carries unique challenges and potential pitfalls. Parts on hand are not unlimited. Repeated component failures are an indication of poor design. Your TA may ask you to review your design before you are issued replacements. Each
design choice has consequences in terms of system complexity, cost, and manufacturability. Be prepared to explain your decisions.