Lobo Electronics Inc

To,
Members of Engineering Consulting Consortium
322 Electronics NE,
Albuquerque, NM 87131

Dear Consulting Team Members:

We are a retail manufacturer of electronics equipments and power supplies for laboratory research. We wish to manufacturer high quality amplifiers using Field Effect Transistor (FET) and Bipolar Junction Transistor (BJT) technology for some of customers who need them for making state of art sound systems. Before we manufacture these amplifiers, we wish to obtain some consulting. Your company was referred to us by a member of our advisory board. We would appreciate it if you can help with this design.

Here is the design problem statement:
Design and build a multi-stage amplifier (you can use a FET or BJT circuit) using a maximum of *six* transistors, which would meet the specifications stated by our customers, which are

> Voltage Gain: A_v = 50;
> Maximum Symmetrical Swing = At least +/- 0.8V;
> Input Impedance: 70 kΩ
> Output Impedance: 8Ω
> Available power supplies are voltage regulated +12V and –12V.
> Frequency Range: 20Hz-20KHz
> Verify this with SPICE simulations.
> Build the actual circuit

These specifications are to be met over the commercial temperature range of 10-80 ºC. If the temperature variation of the parameters is not given, you can assume that β or h_{fe} of the transistors varies from 50% to 150% of its nominal value specified in the spec sheet. You can use a standard FET/BJT transistor. It may be useful to also use a BiCMOS technology that utilizes the high gain and low out impedance of the BJT and the high input impedance of the FET technology. You can read more about BiCMOS at http://en.wikipedia.org/wiki/BiCMOS
Make sure to include the spec sheet of the transistor. Use standard values for resistors and capacitors. You will need to verify your design with a computer simulation.

Deliverables:

I. Team Contract: All the teams are required to develop a 1-2 page team contract that clearly states among other things the roles and responsibilities of each member, conflict resolution techniques etc. The team contract, duly signed by all team members, will be due on *Tuesday March 26th, 2013, in class*.

II. Circuit Inspection: There will be an inspection of the circuits by Prof. Krishna and Matthew Montoya in ECE 311 at *3:00PM on Tuesday April 9th, 2013 (Alpha Teams) and 3:00PM on Thursday April 11th, 2013 (Beta Teams.* All the teams are expected to show their circuit and demonstrate their progress.

III. Team Report: A report (about 3-5 pages) is due in class on *Thursday, April 18th,2013*. Please provide the following information in your report.

1) Circuit diagram

2) Narrative explanation about the circuit design and component choices to meet the circuit specifications.

Calculate the DC Q-points

DC equivalent circuit

Draw the DC and AC load lines

Calculate all the parameters of the AC model

Draw the AC equivalent circuit

3) Performance summary for your design based on SPICE results.
4) Measurement of frequency response of the circuit will be for extra credit

IV. Team Presentation: You will be required to make a 10 minute powerpoint presentation (+ 5mins for questions and answers) about your project in the class on **April 23rd (Teams in Section 1) or April 25th 2013 (Teams in Section 2)**. You can present your design methodology and the choice of the circuit. Feel free to bring the actual circuit to the class to show your classmates (you will be building this amplifier in your laboratory). The design project will be evaluated by an independent panel consisting of faculty members.

Budget and Supplies:
You will be provided a budget of $100 per team for your design project. Please use the components available in Lab ECE 311 (such as wires, capacitors, resistors, transistors and other components). Ms. Kyla Sorenson (Accountant, ECE Department, Accountant III, (505)277-6126), ksorense@ece.unm.edu, ECE Bldg. Rm. 123) has kindly agreed to help out with the purchase of your equipment. She will put all the charges on her p-card. Please have one member of your team be the point of contact for interacting with Kyla and preferably place all the items that you need at the same time. Please send the purchasing requests to Kyla via email. Here is the information that she needs:
Team #:
Vendor:
Item #:
Description of product:
Price per unit:
Quantity:
Link:
If you would like to pay out of pocket for items related to your project, you are more than welcome to purchase it. Kyla can submit their original receipts for reimbursement. Keep in mind that she only has 10 days from the date of purchase to submit reimbursements to the appropriate accounting departments. Note that if you do wish to purchase items out of pocket you will *not* be reimbursed for taxes.

Some Hints:
- Decide on what technology you would like to use for the amplifier. FET or BJT or BiCMOS
- Think about which configuration you will choose (CS+CS, CS+CD, CE+CE, CE + CC, cascade, cascode, Darlington etc…)
- Consider the biasing scheme to be used
- Consider how you will match this with a microphone and speaker consider the loading effect.
- Consider how much power will be dissipated in your circuit. Remember you would like to minimize your power dissipation.
- In many of the SPICE models, you can vary the temperature and see the effect on the circuit. Do that to ensure that your circuit meets the specs in the specified temperature range.

Thanks for your cooperation,

Mr. B. J. Taylor and F.E. Taylor,
Research and Development Manager, Lobo Electronics Inc.