ROBOTICS AND COMMUNICATIONS SYSTEMS ENGINEERING TECHNOLGY
TRANSISTOR AMPLIFIER LAB
3RD SEMESTER, SR. INSTRUCTOR TIM LEISHMAN

General Objective:

Upon completion of this lab, the student will be able to:

A. Calculate DC voltages and currents, biasing current paths, signal current paths, amplifier gains, amplifier frequency response – including upper and lower critical frequencies & bode plot.
B. Demonstrate the proper use of the oscilloscope, DMM, and sweep audio generator to obtain accurate measurements.

References:

- Theory notes
- First Year Text & Lab books
- Tektronix AFG1022 Function Generator Excerpt
- Multistage Schematic
- Multistage PCB Layout

Check-Off Sheet:

- Check-Off Sheet

Specific Objectives:

Notes.

a. See Multistage Schematic
b. DC supply voltage to J2 is 25V
c. J1 & J2 have jumpers installed
d. J5 & J6 have jumpers removed

1. DC Calculations
    a. Draw the amplifier schematic and label all components and test points.
    b. Trace all DC current paths using conventional current flow.
    c. Calculate all DC currents in the circuit, IB_{Q1}, IC_{Q1}, IE_{Q1}, …
    d. Calculate all DC voltages, VBQ1, VCQ1, VEQ1, VR1, VR2, …
    e. Annotate all calculated DC values in a table leaving spots for measured values
    f. **Instructor Check**.

2. DC Measurements
    a. Annotate in previously created table.
    b. **Instructor Check**.

3. AC Calculations
    a. Draw the AC equivalent circuit and trace the signal path.
    b. Calculate the voltage gains for each stage and the total voltage gain
    c. Calculate the current gain of the amplifier
    d. Calculate the power gain of the amplifier
    e. Calculate and draw the DC and AC Load Lines for each stage
    f. Calculate VinpMax and VoutpMax
    g. Annotate all calculated AC values in a table leaving spots for measured values
    h. **Instructor Check.**

4. AC Measurements
    a. Annotate measured values in previously created table
    b. **Instructor Check.**

5. Frequency Response Calculations
    a. Calculate the Lower and Upper Critical Frequencies
    b. Create a Calculated Bode Plot, leave space for a measured Bode Plot
    c. **Instructor Check.**

6. Frequency Response Measurements
    a. Measure the Frequency Response
    b. Create a Measured Bode Plot
    c. **Instructor Check.**

7. 1Khz circuit calculations
    a. With J5 open, calculate and draw the predicted waveforms for a 60mvpp 1Khz input signal. Show the source as the reference and draw the signals at the input and output of each stage and across the load. Show phase and amplitude in reference to the input signal.
    b. **Instructor Check.**

8. 1Khz circuit measurements
    a. Draw measured waveforms
    b. Compare to calculated waveforms
    c. **Instructor Check.**

9. 30hz circuit calculations
   a. With J5 open, calculate and draw the predicted waveforms for a 60mvpp 30hz input signal. Show the source as the reference and draw the signals at the input and output of each stage and across the load. Show phase and amplitude in reference to the input signal.
   b. **Instructor Check.**

10. 30hz circuit measurements
    a. Draw measured waveforms
    b. Compare to calculated waveforms
    c. **Instructor Check.**

11. Pulse Theory Analysis
    a. Use Pulse Theory Square-wave Analysis to measure the amplifiers frequency response.
    b. Clearly document your Pulse Theory measurement steps in your lab book
    c. Compare your Pulse Theory measurements to your step 6 measurements
    d. **Instructor Check.**

12. Additional documentation requirements:
    1. List five factors that limit the high frequency response of transistor amplifiers.
    2. List four factors that limit the low frequency response of transistor amplifiers.
    3. List methods that could be incorporated in an amplifier to improve the high frequency response.
    4. List methods that could be incorporated in an amplifier to improve the low frequency response.
    5. List the amplifier characteristics (voltage gain, current gain, power gain, phase relationship, input impedance, and output impedance) for each type of amplifier: common base, common emitter, and common collector.
    6. Explain why a Common Emitter amplifier always has 180 degrees of signal phase shift from the base to the collector.

13. Complete Conclusion and submit completed Check-Off sheet and Lab writeup in Moodle.