Robotics and Communication Systems Engineering Technology

Lab Experiment 3
BIPOLAR TRANSISTOR AUDIO AMPLIFIER

OBJECTIVE:
After completion of this unit the student should be able to; trace current flows, calculate DC voltages and currents, voltage gains, upper and lower critical frequencies, amplifier phase shift, and draw a Bode plot. Design and build a push pull amplifier as a third stage to the amp. The student should also demonstrate the proper use of the oscilloscope, DVM, and sweep audio generator to measure the previously calculated parameters.

REFERENCES
1. 1^{st} and 2^{nd} Semester books and notes
2. 3^{rd} Semester Theory notes

EQUIPMENT AND MATERIALS
1. Oscilloscope as assigned
2. DVM
3. Audio sweep generator
4. Power supply
5. Two stage amp from your instructor.

SPECIFIC OBJECTIVES

(Do objectives 1-10 below and have your instructor check your work **before** you get your circuit from your instructor.)
NOTE: On the 2-stage schematic, Vcc=25V. There is a jumper on J1 and J3. No Jumper on J5 and J6.

1. Draw the schematic of the amplifier. Label all components and test points.

2. Trace all DC current flows (Show conventional current flow).

3. Draw the AC equivalent circuit, and trace all signal paths

4. Calculate all DC currents in the circuit. Ic1, Ib1, Ie1……ect

5. Calculate all DC voltages. Vc1, Vb1, Ve1, VR1, VR2, Vce ……ect.

6. Calculate and Draw the DC and AC Load line for each stage.

7. Calculate stage voltage gains and total voltage gain of the amplifier.

8. Calculate the Lower and Upper critical frequencies and draw the predicted Bode plot.

9. Calculate and draw the predicted waveforms for 60mvpp in at 1KHz. Show the source as the reference and draw the signals at the input and output of each stage and across the load. Show in your drawing phase and amplitude in reference to the source signal.

10. Calculate and draw the predicted waveforms for 60mvpp in at 30Hz. Show the source as the reference and draw the signals at the input and output of each stage and across the load. Show in your drawing phase and amplitude in reference to the source signal.

(Have your instructor check your calculations and get your circuit from your instructor (1))

11. Measure:
    a. All DC voltages
    b. AC waveforms Vin, Vb1,Vc1,Vb2,Vc2, Vload (vin = 60mvpp at 1KHz) (Measure the phase shifts) Calculate the voltage gain of each stage and total voltage gain from your measurements.
    c. AC waveforms Vin, Vb1,Vc1,Vb2,Vc2, Vload (vin = 60mvpp at 30Hz) (Measure the phase shifts) Calculate the voltage gain of each stage and total voltage gain from your measurements.
    d. Draw a table to compare the measured and calculated AC and DC voltage values and voltage gains
    e. Measure the bandwidth of the amplifier and draw the bode plot.
    f. Look at the bandwidth using the audio sweep generator. Document how you connected your equipment and your circuit and write procedures on how you do it.

12. Explain what emitter peaking is and how it works. Calculate the capacitor needed for emitter peaking.

13. Measure the effects of shunt, series and emitter peeking on your amplifier. Draw a bode plot comparing the original response and the effects of each peaking type **Verify emitter peaking with your instructor using the sweep generator to see the response (2).**

14. Remove the load resistor from your circuit to add a push-pull amplifier stage to your amplifier on your proto board. Show in your lab book your design and the DC voltages you should measure around the circuit.

15. Measure the DC and AC voltages around your push pull amp and verify its operation.

16. Verify your final working amplifier with a push-pull added to your instructor **(3).**

Document in your lab book:

1. List five factors that limit the high frequency response of a transistor amplifier.

2. List four factors that limit the low frequency response of a transistor amplifier.

3. List methods that could be incorporated in an amplifier to extend the high frequency response.

4. List methods that could be incorporated in an amplifier to extend the low frequency response.

5. List the characteristics (voltage gain, current gain, power gain, phase relationship, input impedance, output impedance) for each type of amplifier: common base, common emitter, and common collector.

6. Explain why a Common Emitter amplifier always has a 180 degrees of phase shift from the base to the collector.