BİLKENT UNIVERSITY
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

EE 311 ELECTRONICS II

Experiment 3

Lab Report

BJT Amplifier with β-insensitive biasing

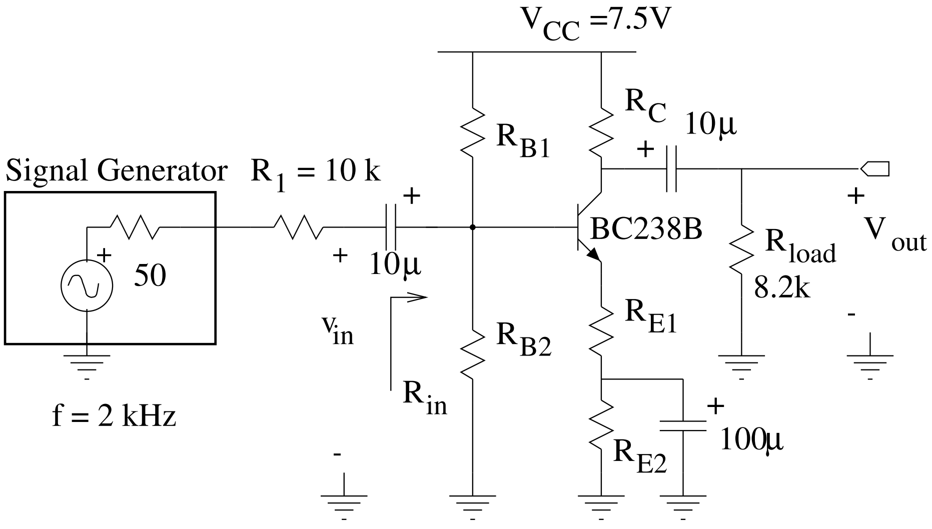
Student Name:

ID Number:

Date:

INTRODUCTION

In this experiment, you will design, construct, and evaluate a single-stage BJT amplifier that employs β-insensitive biasing. Your design will have to meet the specifications listed below.



PRELIMINARY WORK

1. Design a single-stage β-stable BJT amplifier based on the circuit topology given in the figure. Note that the amplifier is loaded by a 8.2 kΩ resistor. The nominal current gain for transistor BC238B is $\beta = 280$. The following specifications must be met by the circuit:

- Voltage gain $A_v = v_{out}/v_{in} > 30$
- Input resistance $R_{in} > 5$ kΩ
- Peak-to-peak undistorted voltage swing at the output > 2 V

Determine the values of R_{B1}, R_{B2}, R_{E1}, R_{E2}, and R_C. Choose $25\ \Omega < R_{E1}$ so that the voltage gain is relatively insensitive to transistor parameters, but $R_{E1} < 50\ \Omega$ so that voltage gain is not compromised too much. Use nominal 10% resistor values only. Try to leave some margin of safety in meeting the above specifications.

The resistor R_1 is included in the circuit to help measure the input resistance R_{in}. Measuring the AC voltage over R_1 will allow you to determine the AC current i_{in} at the input of the amplifier. Dividing v_{in} by i_{in} will allow you to determine R_{in}.

2. Analyze the circuit you designed in part 1 for $\beta = 200$, $\beta = 280$ (design β), and $\beta = 400$. Tabulate the values of V_{BQ}, I_{CQ}, V_{CEQ}, and A_v for all three values of β.

3. Perform the following SPICE simulations. Append the pages containing the input decks and the results of SPICE simulations to the end of this report.

(a) Calculate the voltage gain at 2 kHz.

(b) Calculate the frequency dependence of the voltage gain from 20 Hz to 30 MHz.

(c) Calculate the input resistance at 2 kHz.

(d) Calculate the maximum peak-to-peak output swing.

A SPICE model that can be used for transistor BC238B can be found at:
`http://www.ee.bilkent.edu.tr/~aytur/courses/ee311/labs/bc238b.txt`

EXPERIMENT:

1. Construct the amplifier that you designed in part 1 of the preliminary work section, and verify that your design meets the specs. In this report,

- show the test setup for each specification
- show the scope and multimeter readings.

Tabulate the measured values of V_{BQ}, I_{CQ}, V_{CEQ}, R_{in}, A_v, and peak-to-peak undistorted output swing.

Call the TA and demonstrate the performance of your circuit. Your circuit must meet the specs before you leave the lab room.

2. Replace transistor BC238B that you used in the amplifier with BC237B that has a nominal $\beta = 350$. Tabulate the measured values of V_{BQ}, I_{CQ}, V_{CEQ}, R_{in}, A_v, and peak-to-peak undistorted output swing. Compare with those measured in part 1.