ASSIGNMENT 01 – DC Analysis

Prologue

The EN2110 assignment series from Assignment 01 to Assignment 04 is designed to provide a power amplifier design experience to the ENTC students. In this series of assignments, you will be starting with a reference amplifier circuit. The first assignment itself guides you to derive the design equations for DC analysis. The second and third assignments will guide you to derive equations for small-signal analysis and power analysis of the amplifier, respectively. The final assignment will guide you in the calculation of the resistor values to satisfy the design specifications. The coupling capacitor calculations are not included in this assignment series. A separate session will be conducted to discuss your answers and guide you in simulating such circuits to investigate the operating point, DC sweep, AC sweep, and time-domain behavior.

To do this, you need everything you learned about transistor circuits from Electronics I to Electronics III.

May the force be with you!

INSTRUCTIONS

- This assignment contains 6 questions which accounts for 15 marks.
- Clearly state any assumptions you made.
- Scan your answer scripts using a tool such as cam-scanner to compile it as a PDF. Submission file name should be in the following format.

  <assignment_number>_<index_number>

  For example, if your index number is 070022G and you are submitting the answers for assignment 1, the file name should be,

  A01_070022G

- If you are having any problems, send an email to "thilinaa@uom.lk" with the subject "EN2110-B18-<assignment number>".

A two-transistor cascaded amplifier is shown in Fig. 1. The DC current-gain of the transistors Q_1 and Q_2 are β_1 and β_2, respectively. In this circuit, we assume that the capacitors are large enough to block the DC voltages and allow all AC signals to flow through them. Furthermore, all junction-capacitances of the transistors are negligible within the frequency band of interest.

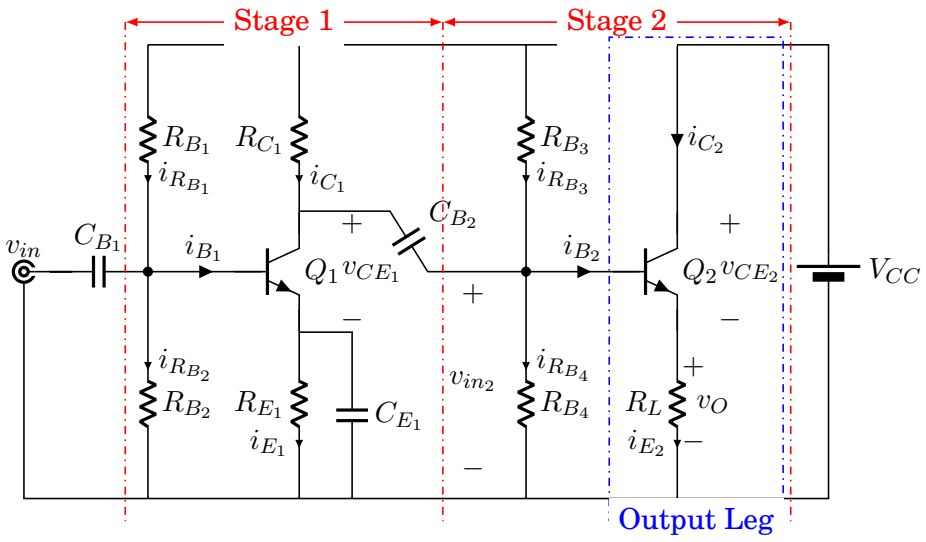

Figure 1: A two stage transistor amplifier.

In this assignment, you will be analyzing the circuit in Fig. 1 by deriving design equations for its DC operation. Stage 1 and stage 2 are DC isolated by the capacitor C_{B_2}. Therefore the DC analysis can be performed for each stage separately.

1. Identify the transistor configurations in stage 1 and stage 2, giving reasons. [4 marks]
2. Write down an expression for V_{CE_1}, using I_{C_1}, I_{E_1}, R_{C_1}, R_{E_2}, and V_{CC}. [1 mark]
3. Simplify the expression obtained in (2) using the relationship between transistor currents and current gain to an expression comprised of V_{CE_1}, I_{B_1}, β_1, R_{C_1}, R_{E_2}, and V_{CC}.

   [2 marks]
4. Write down an expression to indicate the relationship between V_{CC}, $I_{R_{B_1}}$, $I_{R_{B_2}}$, R_{B_1}, R_{B_2}, and I_{B_1}. [1 mark]
5. Follow the steps in questions (2), (3), and (4) to obtain the voltage-current relationships of the stage 2 circuit. [4 marks]
6. Write down an expression for the total power consumed by the amplifier circuit.

   [3 marks]