

EE 3110 Analogue Electronic Circuits
2018-2019 Semester B
Assignment 1

Instructions:

- a. This assignment has **TWO** questions which scores 100 marks totally.
- b. Submit a scanned soft copy through CANVAS on or before **14 March 2019 (Thursday) 11:55pm**, and the hardcopy to me on **15 March 2019 (Friday)** at the beginning of the lecture of EE3110.
- c. TYPING of your solution is **NOT** required. However, you need to **print the assignment in hardcopy and write down your solution on the hardcopy for easy grading.**
- d. **PLAGIARISM** is **PROHIBITED**. If you are being caught, you may **FAIL** in this course.
- e. My advice is that it is better for you to give up in submitting this assignment rather than commits plagiarism. It is better to loss the marks of one assignment than the whole courses due to plagiarism.

Question 1 [70 marks]

Figure 1(a) shows a transistor amplifier circuit using an NPN transistor with $V_{CC} = 15V$, $R_1 = 91k\Omega$, $R_2 = 12k\Omega$, $R_C = 1k\Omega$, and $R_E = 100\Omega$. The hybrid-pi model of the transistor is shown in figure 1(b) with parameters $r_\pi = 2.6k\Omega$, $g_m = 38.5 \text{ mA/V}$, $C_\pi = 0.8pF$ and $C_\mu = 0.05pF$. State clearly any assumption made in your working.

- a) What is the configuration of this amplifier, CE, CC, or CB?

Draw its small signal equivalent circuit using the hybrid-pi model as shown in figure 1(b) at mid-frequency. Then, determine R_{in} , R_{out} , $A_V = v_{out}/v_{in}$ and $A_I = i_C/i_i$.

It is desire that the overall lower 3dB cut-off frequency of this amplifier should be smaller than 100Hz, estimate the minimum values required for C_{in} and C_{out} respectively. Suggest practical values for C_{in} and C_{out} .

- b) When a load resistor R_L is connected across the output terminal a-b, v_{out} is decreased to $\frac{1}{4}$ of its original value at mid-frequency, given that the signal applied to v_{in} remains unchanged before and after connecting R_L . What is the value of R_L ?

Under this situation, discuss how the lower 3dB cut-off frequency due to C_{out} will change due to the R_L .

- c) If a $100\mu F$ capacitor, C_E , is connected across R_E in Figure 1(a), estimate the new lower 3dB cut-off frequency of the amplifier.
- d) Estimate the higher 3dB cut-off frequency of the amplifier for the case in part (c).

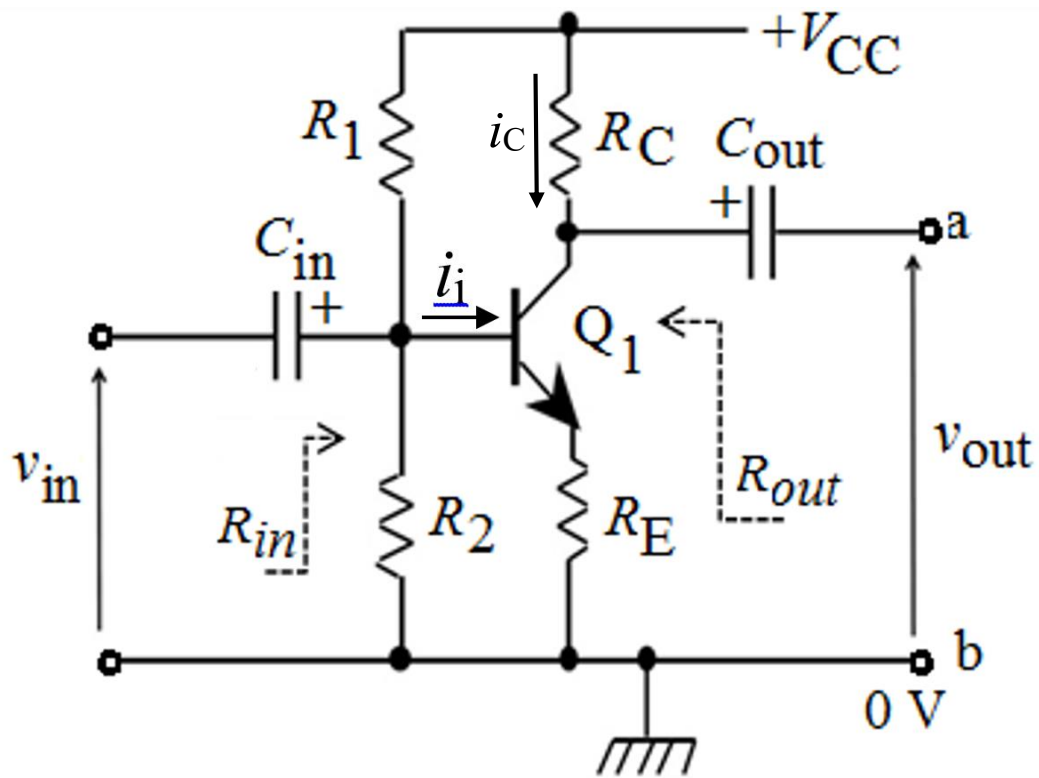


Figure 1(a)

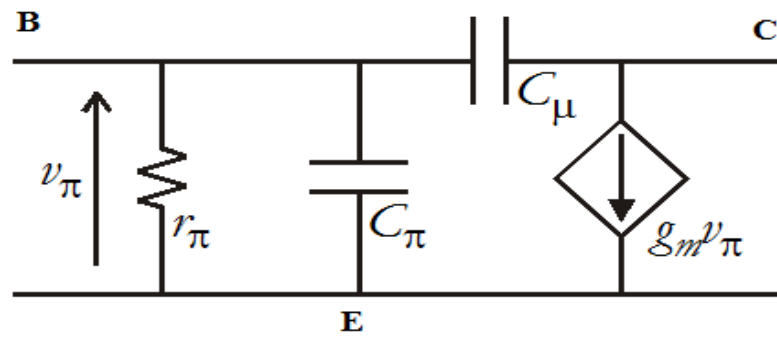


Figure 1(b)

Question 2 [30 marks]

a) Figure 2(a) shows a feedback topology.

- i. Identify the type of feedback topology with justification.
- ii. Given that $v_s = 100\mu\text{V}$, $v_f = 99\mu\text{V}$, and $i_o = 10\text{mA}$, $R_i = 15\text{k}\Omega$ and $R_o = 1\text{k}\Omega$, determine the open loop gain A , the feedback network gain β , the closed loop gain A_f , the closed loop input resistance R_{if} and the closed loop output resistance R_{of} .
- iii. Assume that the open loop gain of the amplifier A exhibits a common audio amplifier frequency response. Given that its 3dB cut-off frequency is 100Hz, determine the corresponding closed loop 3dB cut-off frequency.

b) Figure 2(b) shows a two-stage transistor amplifier. You may assume that the speaker is equivalent to a resistor in both ac and dc analysis.

- i. Discuss whether R_2 can form a negative feedback between the base of T_1 and the emitter of T_2 .
- ii. What type of negative feedback topology is it? Justify your answer.
- iii. Draw the equivalent circuit of the feedback network and discuss whether it is a non-ideal feedback network. Define and determine the parameters R_x , R_y and β in terms of the feedback network resistor.

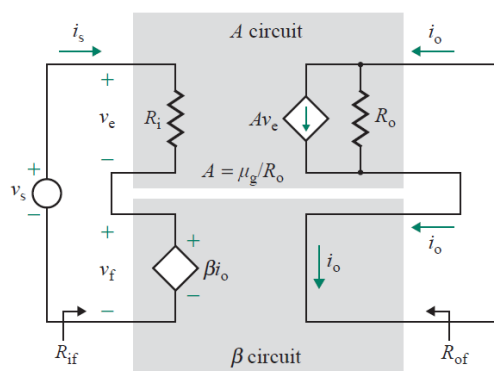


Figure 2(a)

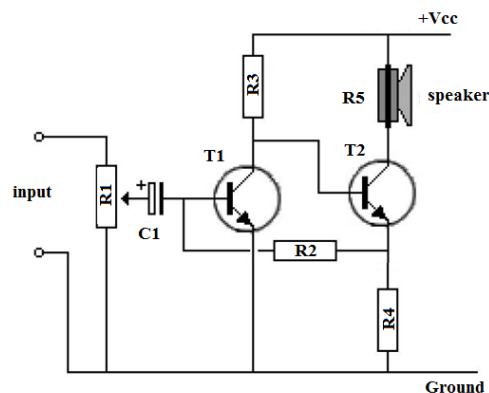


Figure 2(b)