EE6341 Assignment 1

Instructions:

- This assignment contains one question at page 1, from parts (a) to (c) and one figure.
- The answers should be handwritten on A4 size papers.
- Indicate clearly the **total number of pages** and **matriculation number** on the first page, and **name** on every page of the answer sheets.
- Please submit your completed hardcopy solution of the assignment just after the EE4341/EE6341 class on **10 September, 2024.**

Question: For the AC equivalent circuit of a common-emitter BJT amplifier shown in Figure 1, assume that $V_{CC} = 10$ V, $V_{BE} = 0.7$ V, $R_S = 5$ kΩ, $R_B = 100$ kΩ, $R_L = 1$ kΩ, $C_{b'e} = 2$ pF, $C_{cb'} = 1$ pF, and $C_L = 1$ pF. Assume bias current $I_B = 25$ μA, Boltzmann's constant k = 1.38 $\times 10^{-23}$ J/K, q =1.6 $\times 10^{-19}$ C, T = 300 K, $V_T = 26$ mV, $\beta = 100$, $r_{bb'} = 100$ Ω, and ignore r_o. Assuming the equivalent noise bandwidth is 100 kHz, and neglecting the flicker noise and all capacitive effect.

Note: For the BJT biased on the forward active region: $r_\pi = \dfrac{V_T}{I_B}$, $g_m = \dfrac{I_C}{V_T}$.

(a) Calculate the total equivalent input rms noise voltage and current by looking into node **a**.

(b) Calculate the total equivalent input rms noise voltage and current by looking into node **b**.

(c) Discuss if a transformer (with turn ratio *1:N*) can be incorporated into point b to minimize the total input referred noise? If yes, what is the *N* to be?
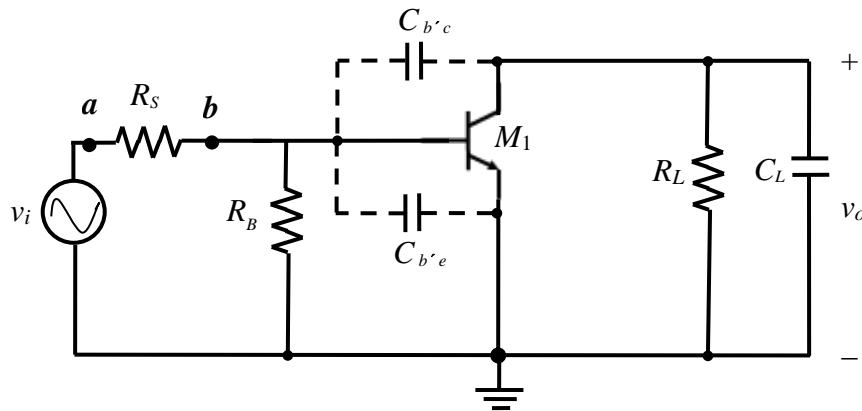

Figure 1