國立中山大學113學年度
碩士班暨碩士在職專班招生考試試題

科目名稱：電子學【IC設計所碩士班】

—作答注意事項—

考試時間：100分鐘

- **考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。**請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- **答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示**，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
- 答案卡請以2B鉛筆劃記，不可使用修正液（帶）塗改，未使用2B鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- **試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：電子學【IC 設計所碩士班】　　題號：483002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題）　　

[Problem 1] **(20%)** For the circuit shown in Fig. 1, let $\beta = 125$, $V_{BE(on)} = 0.7$ V, and $V_A = 200$ V.

(a) Plot the dc and ac load lines on the same graph. (10%)

(b) Determine the maximum symmetrical swing in the output voltage for $i_C > 0$ and $0.5 \le v_{CE} \le 9.5$ V. (10%)

Please note that you need to show how you derive the results.

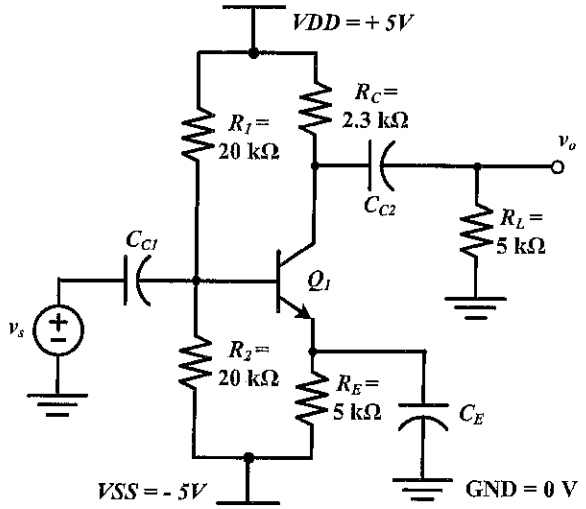

Fig 1

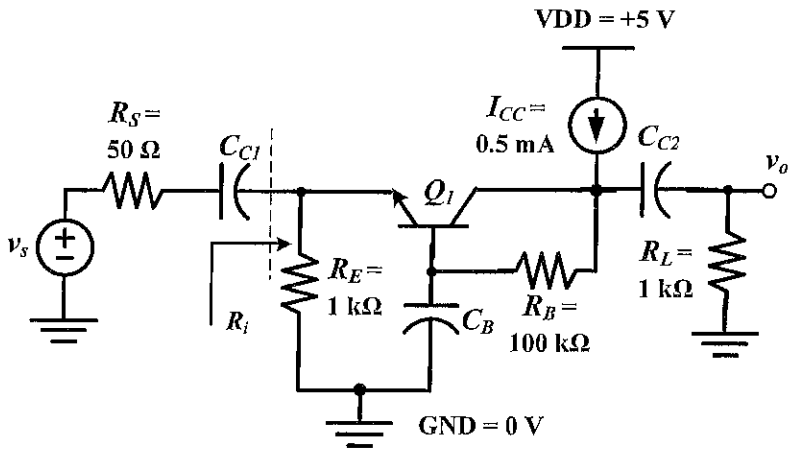

Fig. 2

[Problem 2] **(19%)** For the circuit shown in Fig. 2, the transistor parameters are β =100 and $V_A = \infty$.

(a) Determine the dc voltages at the collector, base, and emitter terminals. (9%)

(b) Determine the small-signal voltage Av = v_o/v_s. (5%)

(c) Find the small-signal input resistance R_i. (5%)

[Problem 3] **(14%)** A three-pole feedback amplifier has a loop gain given by

$$T(f) = \frac{\beta(10^5)}{\left(1 + j\frac{f}{5 \times 10^2}\right)\left(1 + j\frac{f}{10^4}\right)^2}$$

(a) Determine the frequency f_{180} at which the phase is -180 degrees. (7%)

(b) At the frequency f_{180}, determine the value of β such that $|T(f)| = 1$. (7%)

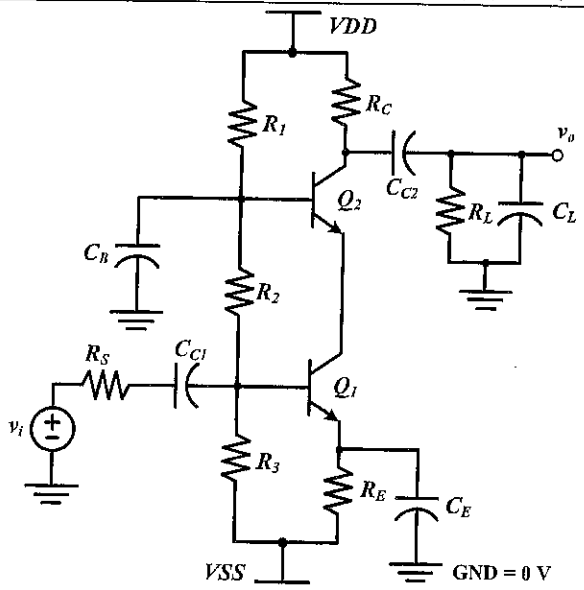

Fig. 3

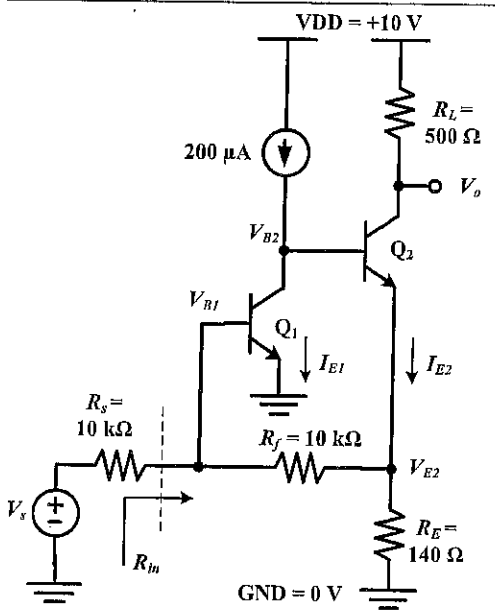

Fig. 4

[Problem 4] **(21%)** For the cascode circuit shown in Fig. 3, the circuit parameters are VDD = 10 V, VSS = -10 V, R_S = 0.1 kΩ, R_1 = 42.5 kΩ, R_2 = 20.5 kΩ, R_3 = 28.3 kΩ, R_E = 5.4 kΩ, R_C = 5 kΩ, R_L = 10 kΩ, C_L = 0. The transistor parameters are β_O = 120, $V_A = \infty$, $V_{BE(on)}$ = 0.7 V, C_π = 12 pF and C_μ = 2 pF.

(a) If C_L is an open circuit, determine the 3 dB frequency corresponding to the input and output portions of the equivalent small-signal circuit. (12%)

(b) Determine the midband voltage gain. (6%)

(c) If a load capacitor C_L = 50 pF is connected to the output, determine if the upper 3 dB frequency is dominated by the load capacitance or by the transistor characteristics. (3%)

[Problem 5] **(26%)** For the amplifier circuit in Fig. 4, assuming that $V_{BE(on)}$ = 0.7 V, β =100, and V_s has a zero dc component, answer the following questions.

(a) Find the dc voltages at all nodes (V_{B1}, V_{B2}, V_{E2}, and V_o) and the dc emitter currents of Q1 and Q2 (I_{E1}, and I_{E2}). (18%)

(b) Use feedback analysis to find V_o/V_s and R_{in}. (8%)