國立中山大學109學年度
碩士暨碩士專班招生考試試題

科目名稱：電子學【電波聯合碩士班選考、通訊所碩士班乙組選考、電機系碩士班戊組選考】

－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，不得另攜帶紙張，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，其後果由考生自行負擔。
- 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，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）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 109 學年度碩士暨碩士專班招生考試試題

科目名稱：電子學【電波聯合碩士班選考、通訊所碩士班乙組選考、電機系碩士班戊組選考】題號：482003

※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）

1. (15%) A second-order filter has its poles at $s = -(1/2) \pm j(\sqrt{3}/2)$. The transmission is zero at $\omega = 2$ rad/s and is unity at dc ($\omega = 0$). Find the transfer function. (15%*1)

2. (25%) For the common-emitter amplifier shown in Fig. 1, let $V_{CC} = 9$ V, $R_1 = 27$ kΩ, $R_2 = 15$ kΩ, $R_E = 1.2$ kΩ, and $R_C = 2.2$ kΩ. The transistor has $\beta = 100$ and $V_A = 100$ V. (a) Calculate the dc bias current I_E. If the amplifier operates between a source for which $R_s = 10$ kΩ and a load of 2 kΩ, (b) replace the transistor with its hybrid-π model, and (c) find the values of R_i, (d) the voltage gain v_o/v_s, and (e) the current gain i_o/i_i. (5%*5)

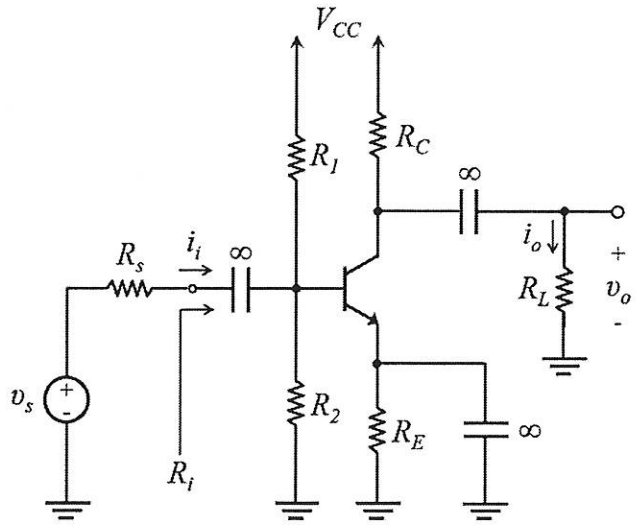

Fig. 1

3. (30%) The current-steering circuit of Fig. 2 is fabricated in a CMOS technology for which $k_n' = 90$ μA/V^2, $k_p' = 30$ μA/V^2, $V_{tn} = 0.8$ V, and $V_{tp} = -0.9$ V. If all devices have $L = 2$ μm, design the circuit so that $I_{REF} = 20$ μA, $I_2 = 100$ μA, and $I_5 = 40$ μA. Use the minimum width of 2 μm for as many of the devices as possible. (a) Give the required width for each transistor and the value of R required. (10%) (b) What is the highest voltage possible at the drain of Q_2? (c) What is the lowest voltage possible at the drain of Q_5? If $V_{An} = 8\ L$ and $|V_{Ap}| = 12\ L$, where L is in μm and V_{An} and V_{Ap} are in volts, (d) find the output resistance of the current source Q_2, and (e) the output resistance of the current sink Q_5. (5%*4)

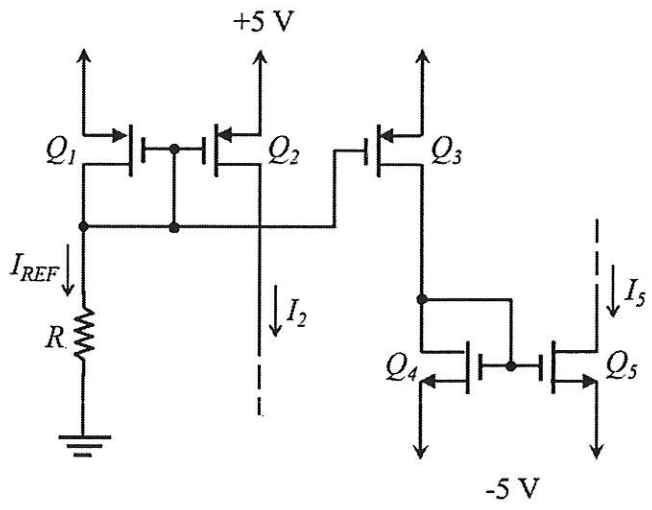

Fig. 2

試題請隨卷繳回，請留意背面是否有題

4. (30%) For the common-base circuit in Fig. 3, assuming the bias current to be about 1 mA, β = 100, C_μ = 0.8 pF, r_e = 25 Ω, and f_T = 600 MHz:
   (a) Estimate the midband gain V_o/V_s.
   (b) Use the short-circuit time-constants method to estimate the lower 3-dB frequency, f_L. (*Hint:* In determining the resistance seen by C_1, the effect of the 47-kΩ resistor must be taken into account.)
   (c) Find the high-frequency poles, and estimate the upper 3-dB frequency, f_H. (10%*3)

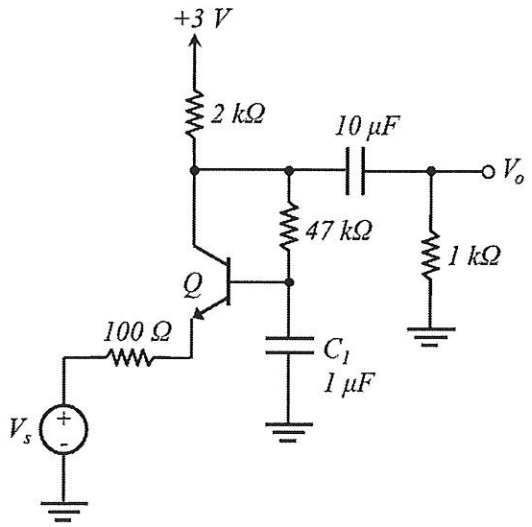

Fig. 3