國立中山大學114學年度
碩士班考試入學招生考試試題

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

—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，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。**

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※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） 共 2 頁第 1 頁

1. (15%) A third-order low-pass filter has transmission zeros at ω = 5 rad/s and at ω = ∞. Its natural modes are at $s = -2$ and $s = -0.3 \pm j0.6$. The dc gain is unity. Find the transfer function $T(s)$.

2. (30%) In the circuit of Fig. 1, the NMOS transistor has $|V_t| = 0.9$ V, and $V_A = 100$ V, and operates with $V_D = V_{GS} = 2$ V. (a) What is the voltage gain v_o/v_i ? (10%) (b) What does V_D become when I increase to 1 mA? (10%) And (c) what is the new gain? (10%)

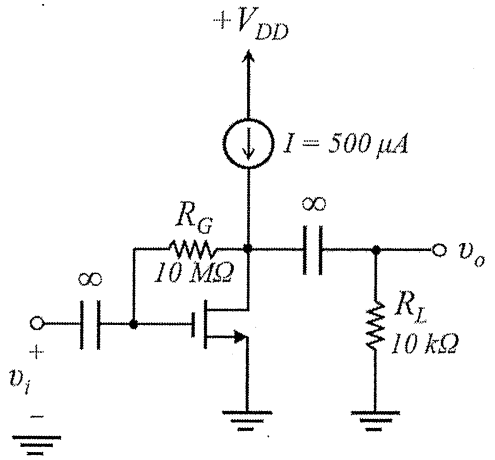

Fig. 1

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? (5%) (c) What is the lowest voltage possible at the drain of Q_5? (5%) If $V_{An} = 6\,L$ and $|V_{Ap}| = 10\,L$, 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, (5%) and (e) the output resistance of the current sink Q_5. (5%)

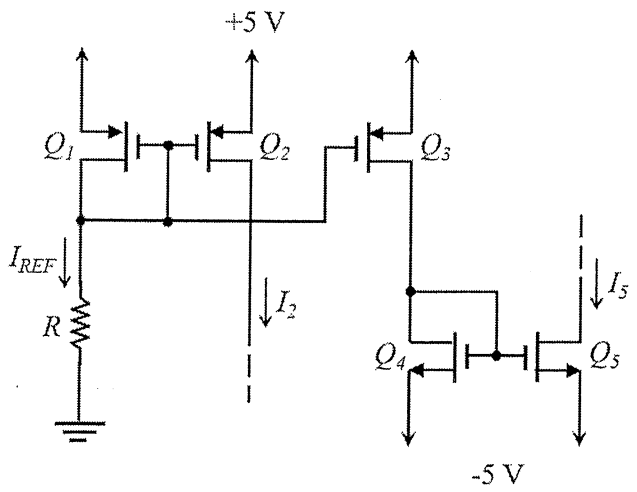

Fig. 2

試題請隨卷繳回，請留意背面是否有題

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4. (25%) In the emitter follower in Fig. 3, the signal source is directly coupled to the transistor base. If the dc component of v_s is zero, (a) find the dc emitter current. Assume $\beta = 120$. (5%) Neglecting r_o, (b) find R_i, (5%) (c) the voltage gain v_o/v_s, (5%) (d) the current gain i_o/i_i, (5%) and (e) the output resistance R_o. (5%)

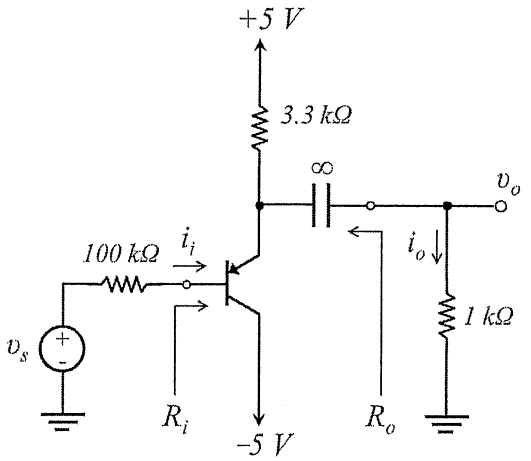

Fig. 3