

國立中山大學 111 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【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，請衡酌作答(不得另攜帶紙張)。
- 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。

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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. (30%) For the common-base circuit in Fig. 1, assuming the bias current to be about 1 mA, $\beta = 100$, $C_\mu = 0.8$ pF, $r_e = 25 \Omega$, and $f_T = 800$ MHz:
 - (a) Estimate the midband gain V_o/V_s . (10%)
 - (b) Use the short-circuit time-constants method to estimate the lower 3-dB frequency, f_L . (10%)
(Hint: In determining the resistance seen by C_1 , the effect of the 47-k Ω resistor must be taken into account.)
 - (c) Find the high-frequency poles, and estimate the upper 3-dB frequency, f_H . (10%)

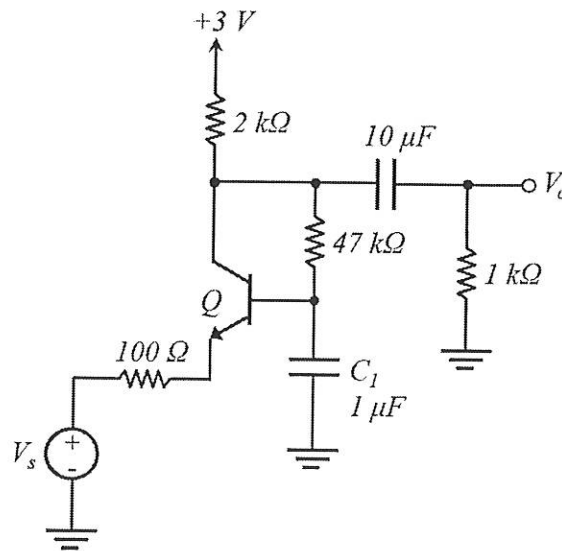


Fig. 1

2. (25%) The current-steering circuit of Fig. 2 is fabricated in a CMOS technology for which $k'_n = 90 \mu\text{A}/\text{V}^2$, $k'_p = 30 \mu\text{A}/\text{V}^2$, $V_{tn} = 0.8$ V, and $V_{tp} = -0.9$ V. If all devices have $L = 2 \mu\text{m}$, design the circuit so that $I_{REF} = 20 \mu\text{A}$, $I_2 = 100 \mu\text{A}$, and $I_5 = 40 \mu\text{A}$. Use the minimum width of $2 \mu\text{m}$ 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 ? If $|V_{Ap}| = 16L$, where L is in μm and V_{Ap} is in volts, (5%) (d) find the output resistance of the current source Q_2 . (5%)

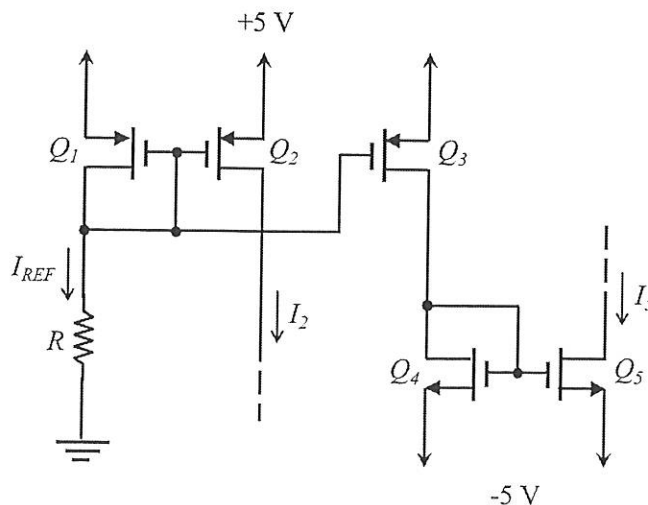


Fig. 2

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3. (15%) A second-order filter has its poles at $s = -(1/8) \pm j(\sqrt{63}/8)$. The transmission is zero at $\omega = 5$ rad/s and is unity at dc ($\omega = 0$). Find the transfer function.
4. (30%) For the emitter-follower circuit shown in Fig. 3 the BJT used is specified to have β values in the range of 20 to 200. For the two extreme values of $\beta = 20$ and $\beta = 200$, find :
- (a) I_E , V_E , and V_B . (10%)
 - (b) the input resistance R_i . (10%)
 - (c) the voltage gain v_o/v_s . (10%)

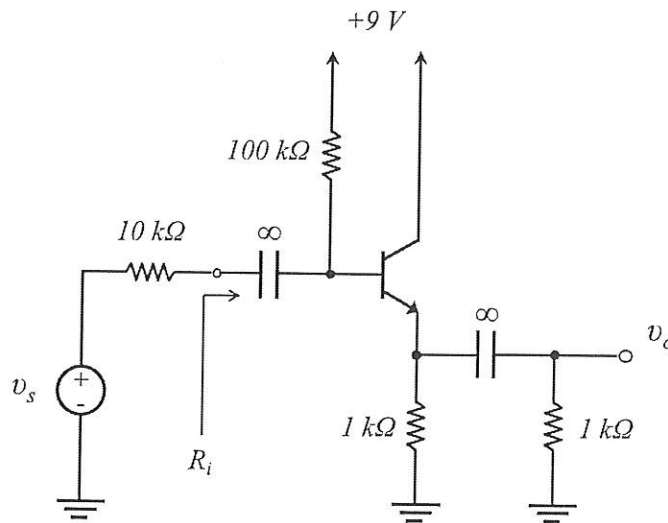


Fig. 3