

八十六學年度 電機工程學 系(所) 乙 組碩士班研究生入學考試

科目 電子學 科號 3102 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

- (a) What is the I-V characteristic of a diode-connected enhancement MOSFET? Please write down its expression and qualitatively plot the characteristic. (5%)
- (b) For the following NMOS amplifier with enhancement load, please plot its load curve on the output characteristics and also plot the transfer characteristic. (10%)
- (c) Derive the linear relation between v_i and v_o when the transistor Q_1 is in saturation. (10%)

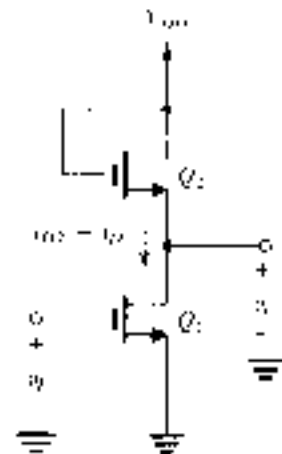
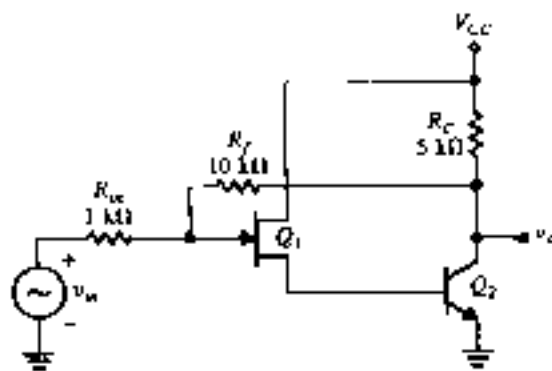


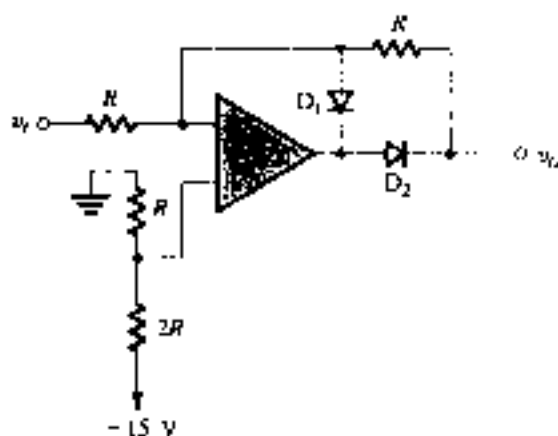
Fig. For Prob. 1

For the following circuit, $g_m = 1 \text{ mS}$ or 1 mA/V and $r_o = \infty$ for FET Q_1 , and $r_{\pi} = 1 \text{ k}\Omega$ and $\beta = 100$ for BJT Q_2 .

- (a) Find the circuit voltage gain v_o/v_{in} with R_f removed. (5%)
- (b) Find the circuit voltage gain with R_f in place. (9%)



3. Plot the transfer characteristic of the following circuit. (10%)



4. It is a common practice to use current mirrors in IC designs for biasing circuits. There are two popular ways to design a current source which has a fixed ratio to a reference current I_{REF} , one is using the Widlar current source.

2% (a) What is the other circuits technique to obtain a ratioed current mirror?

2% (b) Draw the Widlar current source circuits

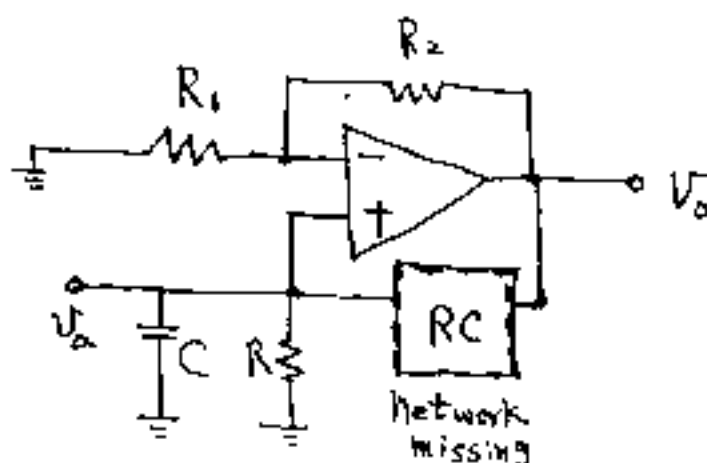
6% (c) Design a Widlar current source to generate a current $I_C = 10\mu A$ given that $I_{REF} = 1mA$, if at a collector current of $1mA$ $V_{BE} = 0.7V$ and $V_T = kT/q$ at room temperature approximately equals to $26mV$, determine the emitter resistor R_E in the Widlar current source circuits.

5. A Wein-Bridge oscillator has part of the circuits missing as shown in the figure.

3% (a) Add in an RC network to complete the circuits.

4% (b) Apply the Barkhausen criterion to derive the oscillation frequency ω_0 in terms of the components, and the minimum ratio of R_2/R_1 .

3% (c) To use a thermistor (which has a negative temperature coefficient of resistance) as an amplitude stabilization component of the oscillator, to where should this thermistor be connected?



6 (10%) For the conventional CMOS dynamic power,

(a) Write down the equation in terms of α , V_{DD} , C , and f , where α , V_{DD} , C , and f are, respectively, the number of transitions, supplied voltage, load capacitance, and operating frequency.

(b) From this equation, what is the most effective way to reduce CMOS dynamic power?

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7 (15%) If the data stored in the ROM are (C, D) 00, 01, 10, and 11 as input (A, B)= 00, 01, 10, and 11, respectively. Complete the circuit (use NMOS FETs and Ground signal)

