

國立聯合大學 104 學年度碩士班考試招生

電機工程研究所 入學考試試題

科目： 電 子 學

第 1 頁共 3 頁

1. (20%) Please indicate whether each of the following statements is always true or sometimes false. Justify your answer by giving a logical argument, otherwise the score will not be counted. (4 points for each)

- (a) A NMOSFET is said to have entered the triode region operation if $v_{GS} \geq V_t$ and $v_{DS} \leq v_{GS} - V_t$.
- (b) An ideal current amplifier is usually considered to have infinite input impedance and zero output impedance.
- (c) Since BJT is a nonlinear device, the superposition theorem can not be applied in its analysis. Therefore performing the DC and AC analyses separately of a BJT amplifier is not reasonable.
- (d) A negative feedback amplifier can reduce the closed-loop gain but increase the gain sensitivity.
- (e) A resistance $r_o = \frac{V_A}{I_D}$ between the Drain and the Source can model the Early effect of the MOSFET in the triode region.

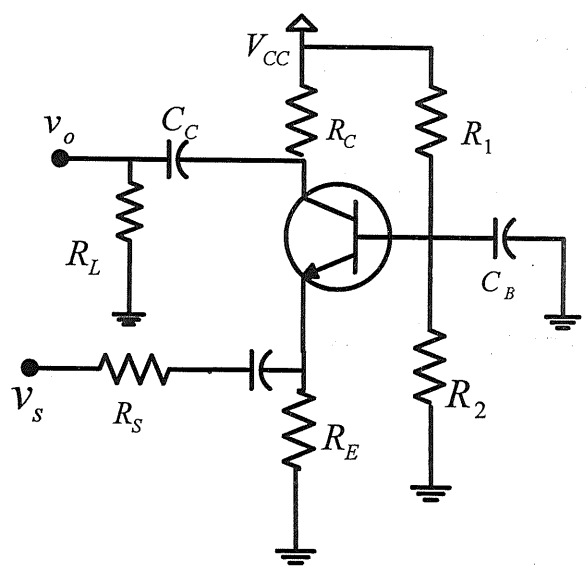
2. (20%) Consider the following amplifier with $R_1 = 50k, R_2 = 10k, R_C = 1k, R_E = 0.4k, \beta = 100$ and

$V_{CC} = 15V$, evaluate the following : (a) the DC operation point . (5%)

(b) the input and output resistances $R_i|_{R_s=0}$ and $R_o|_{R_L \rightarrow \infty}$. (5%)

(c) the voltage gain $A_{vo} = \frac{v_o}{v_i}|_{R_L \rightarrow \infty}$. (5%)

(d) the current gain $A_{is} = \frac{i_o}{i_i}|_{R_L \rightarrow 0}$. (5%)



3. (25%) For the following single stage CS amplifier with $\frac{\mu_n C_{ox} W}{2L} = 2 \text{ mA/V}^2$ and $V_{in} = 1, V_A = 100$, evaluate the following :

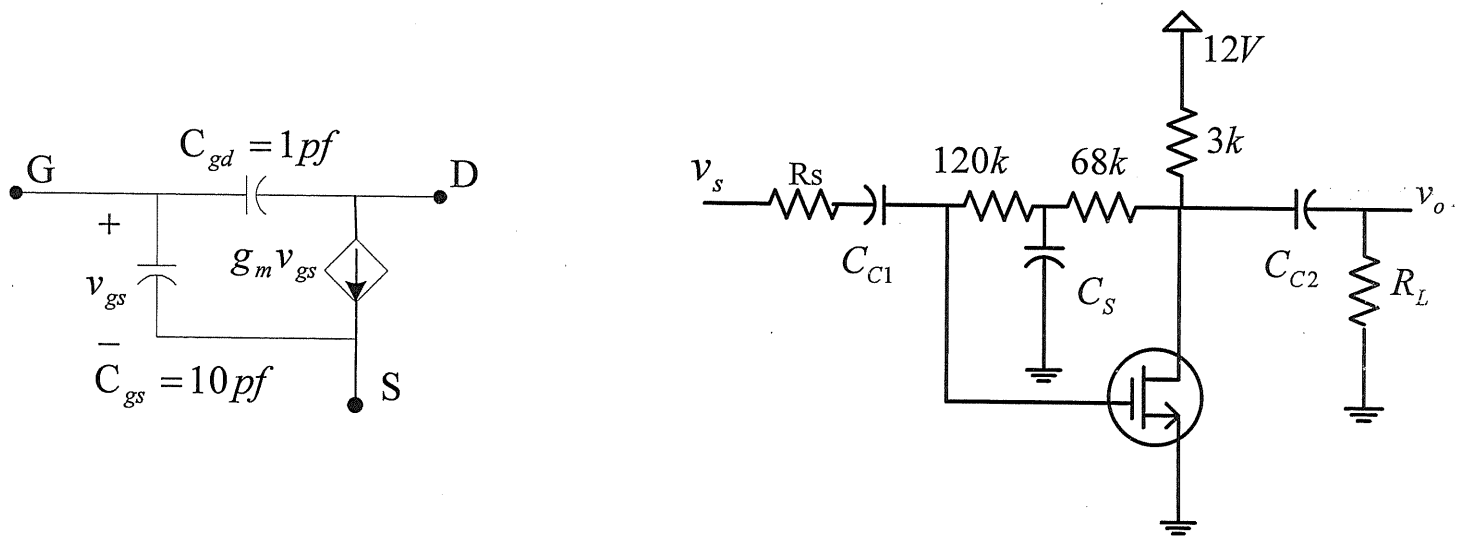
(a) The g_m parameter. (5%)

(b) The input and output resistances $R_i|_{R_s=0}$ and $R_o|_{R_L \rightarrow \infty}$. (5%)

(c) The midband voltage gain $A_m = \frac{v_o}{v_s} \Big|_{\substack{R_s = 1k \\ R_L = 2k}}$. (5%)

(d) The corner frequency ω_{C1} , ω_{C2} and ω_{CS} . with $C_1 = 10 \mu F, C_2 = 20 \mu F$ and $C_S = 10 \mu F$ (5%)

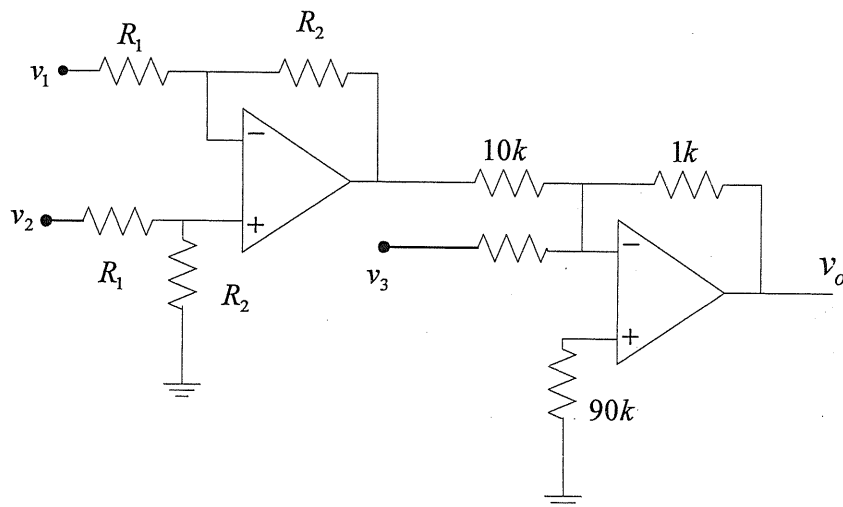
(e) Sketch the Bode diagram $\left| \frac{v_o}{v_i} \right|$. (5%)



4. (15%) Consider the following Op-Amp difference amplifier.

(a) Find the differential input resistance. (5%)

(b) Find $v_o = f(v_1, v_2, v_3)$ (10%)



5. (20%) Consider the following OPA & MOSFET feedback amplifier, the transistor has a $g_m = 2\text{mA/V}$, $V_A = \infty$, the amplifier μ has an input resistance R_{id} , an output resistance R_{ol} , and open-circuit gain μ with the following circuit elements: $R_1 = 1\text{K}$, $R_2 = 10\text{K}$, $R_s = 0.5\text{k}$ Using the feedback method to

- (a) find the feedback network parameters β . (5%)
- (b) find the closed-loop gain A_f . (5%)
- (c) find the input resistance R_{if} , and R_{in} . (5%)
- (d) find the output resistance R_{of} and R_{out} . (5%)

