

國立臺北科技大學 100 學年度碩士班招生考試

系所組別：1521 自動化科技研究所乙組

第二節 電子學 試題 (選考)

第一頁 共二頁

注意事項：

1. 本試題共五題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Figure 1 shows a circuit having an input resistance of $100\text{ k}\Omega$ and a gain that can be varied from -1 V/V to -10 V/V using the $10\text{-k}\Omega$ potentiometer R_4 . What is the voltage gain when the potentiometer is set exactly at its middle value? (14 pts)

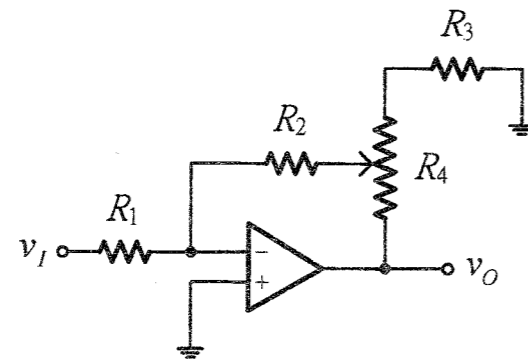


Figure 1

2. In Fig. 2, I is a dc current, v_i is a sinusoidal signal with small amplitude (less than 10 mV) and a frequency of 100 kHz , and the thermal voltage V_T is 25 mV . Representing the diode by its small-signal resistance r_d , which is a function of I . (27 pts, each sub-problem is 9 pts)

- (a) Sketch the small-signal circuit for determining the sinusoidal output voltage V_o .
- (b) Find the phase shift between V_o and V_i .
- (c) Find the value of I that will provide a phase shift of -45° .

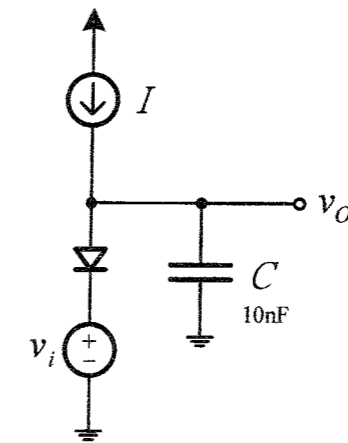


Figure 2

3. The amplifier shown in Fig. 3 has $R_s = R_L = 1\text{ k}\Omega$, $R_C = 1\text{ k}\Omega$, $R_B = 47\text{ k}\Omega$, $\beta = 100$, $C_\mu = 0.8\text{ pF}$ (collector-base junction capacitance), $V_T = 25\text{ mV}$ (thermal voltage), and $f_T = 600\text{ MHz}$ (unity-gain bandwidth) and C_{C1} and C_{C2} are coupling capacitors. (27 pts, each sub-problem is 9 pts)
- (a) Find the dc collector current of the transistor.
 - (b) Find g_m and r_π .
 - (c) Neglecting r_o , find the midband voltage gain from base to collector (neglect the effect of R_B).

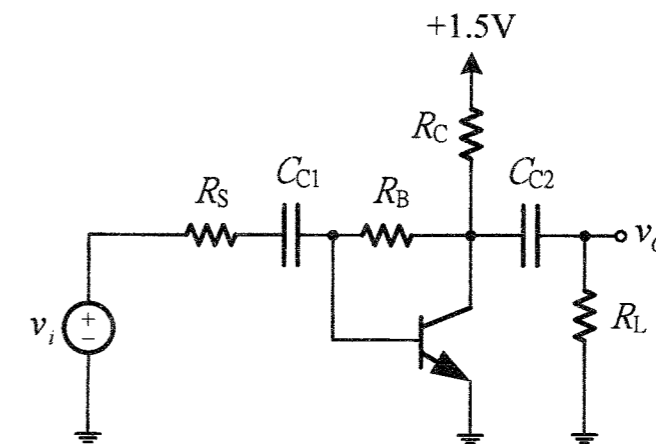


Figure 3

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4. The amplifier shown in Fig. 4 is biased to operate at $I_D=1\text{mA}$, $g_m=1\text{ mA/V}$. Neglecting r_o . (18 pts, each sub-problem is 9 pts)
- (a) Find the midband gain.
- (b) Find the value of C_S that places f_L (the low 3-dB frequency) at 10Hz.

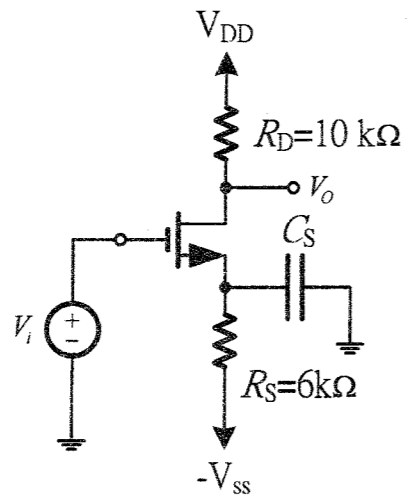


Figure 4

5. Find the logic function implemented by the CMOS circuit shown below. (14 pts)

