

1. (15 %) Explain the following terminologies:  
 (a) Wheatstone bridge circuit; (b) active filter; (c) TTL; (d) logarithmic amplifier; (e) propagation delay.
2. (20 %) Please design experiments to measure input impedance, output impedance, frequency response, and CMRR of an OP-AMP. Describe the setup, principle, and procedures.
3. (15 %) A cardiologist in National Cheng Kung University Hospital wishes to setup an automatic system for acquiring electrocardiography (ECG) (electrical signal of heart). Assumed the amplified ECG amplitude ranges between +5 V and -5 V and frequency ranges from dc to 100 Hz. A minimum resolution of 2.5 mV is required.  
 (a) Please give the specifications for A/D converter of your choice, such as type, resolution, sampling rate, noise, cost, etc., and explain the reasons.  
 (b) Design a low-pass filter for anti-aliasing purpose.
4. The transistor in the circuit shown in Figure 1 has the following low-frequency small-signal parameters:  $g_m=40\text{mS}$ ,  $\beta_0=150$ ,  $r_o \rightarrow \infty$ , and  $r_b=0$ . Determine the small-signal equivalent resistance  $R_{eq}$ . (15%)
5. The FETs in the circuit shown Figure 2 are identical and have  $g_m=2\text{mS}$ , and  $r_d=20\text{k}\Omega$ . The circuit parameters are  $R_D=12\text{k}\Omega$ ,  $R_G=500\text{k}\Omega$ ,  $R_S=50\Omega$ , and  $R_F=5\text{k}\Omega$ . Determine the  $A_F$  and  $R_{OF}$ . (20%)
6. For a Wien-bridge oscillator as shown in Figure 3, Determine the frequency of the oscillation and the ratio of  $R_1/R_2$  for oscillation. (15%)

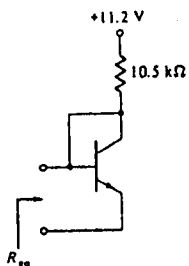


Figure 1.

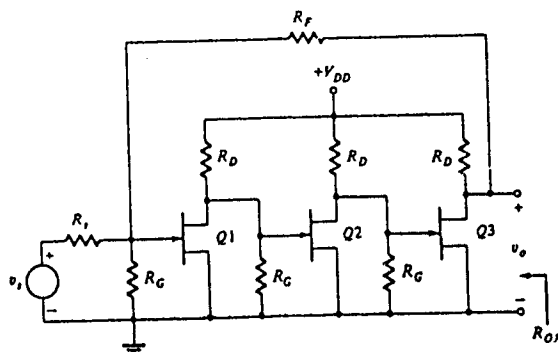


Figure 2.

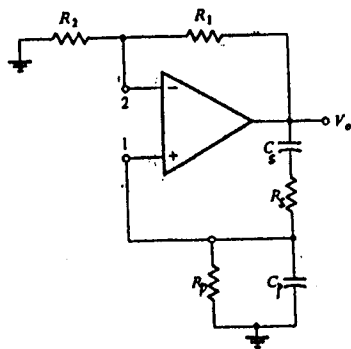


Figure 3.