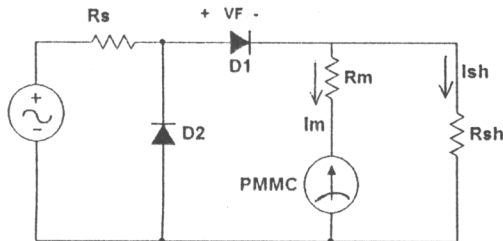
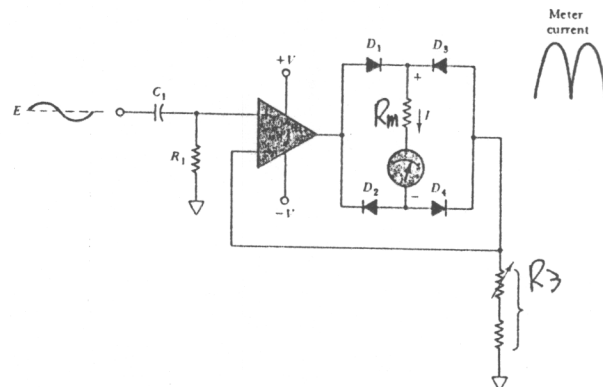


- (10%) 寫出交流電的均方根值(root-mean-square value)電壓之定義，此公式中有平方、積分、除法、及開根號四種數學運算。一般類比式三用電表的主要元件是二極體、電晶體、電阻、電容、再加上 PMMC 儀表及一些控制開關，請解釋類比式三用電表為何可以量測交流電壓的均方根值？它如何執行上述各種複雜的數學運算？  
(Hint: 你可以由以下的考題得到提示，但注意必須寫出重點)
- (20%) A PMMC instrument with  $I_{FSD} = 50 \mu A$  and  $R_m = 1.7 k\Omega$  is used in the half-wave rectifier voltmeter circuit illustrated in the figure shown below. The silicon diode ( $D_1$ ) must have a minimum (peak) forward current of  $100 \mu A$  when the measured voltage is 0.2 FSD. The voltmeter is to indicate 50 V (rms) at full scale.
  - Calculate the values of  $R_S$  and  $R_{SH}$ .
  - Explain the need of  $R_{SH}$  and  $D_2$  for the operation of the circuit.
  - The sensitivity of the voltmeter.



Half-wave rectifier voltmeter

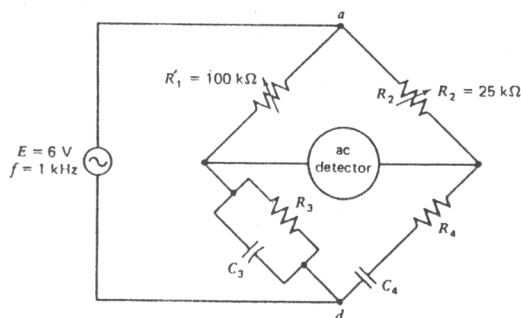
(題 2)



Ac electronic voltmeter that is constructed using V-I converter, full-wave bridge rectification.

(題 3)

- (15%) The full-wave rectifier voltmeter circuit shown above uses a  $500 \mu A$  meter with  $R_m = 460 \Omega$  together with  $R_3 = 450 \Omega$ . Determine the rms input voltage for FSD on the meter.
- (15%) Given the Wein bridge as shown below, find the series-equivalent resistance and capacitance of  $R_4$  and  $C_4$  at balance, when  $Z_3$  equals  $7790 \Omega \angle -72.8^\circ$ .



Wein bridge

(背面仍有題目,請繼續作答)

5. (10%) When designing a voltmeter or an ammeter for direct current, what should be taken into account? What should be taken into account when designing an ac voltmeter or an ac ammeter?
6. (10%) The probe of a Cathode Ray Oscilloscope serves as a voltage divider. The attenuation ratio of the output of the probe to the input keeps constant for any frequency. Draw the circuit diagram and explain why.
7. (10%) Design an instrument that can be used to measure the inductance of an unknown inductor. You can use any principle you have learned.
8. (10%) Try to design a circuit that can be used to measure the frequency of a very high-frequency signal, e.g. more than 1 MHz. CRO (Cathode Ray Oscilloscope) should not be used in this problem.

提示：對正弦函數波形的交流信號而言

$$V_{\text{average}} = 0.637 V_{\text{peak}}$$

$$V_{\text{rms}} = 0.707 V_{\text{peak}}$$

$$V_{\text{rms}} = 1.11 V_{\text{average}}$$

$$V_{\text{average}} \cong 0.9 V_{\text{rms}}$$