1. **(15%)** Explain the operation of a dual-slope-integrator analog-to-digital converter (ADC)? What are the quantizing error and the resolution of a 16-bit ADC?

2. **(20%)** Briefly explain the following terms: (1) Flash memory, (2) Cache RAM, (3) RS232C, (4) IEEE488/GPIB, (5) Handshaking.

3. **(10%)** Using a 4.5 V battery together with a meter that has 100 μA FSD and a coil resistance of 100 Ω, design a series ohmmeter to have a range of 1 kΩ (0.9FSD) to 100 kΩ (0.1FSD).
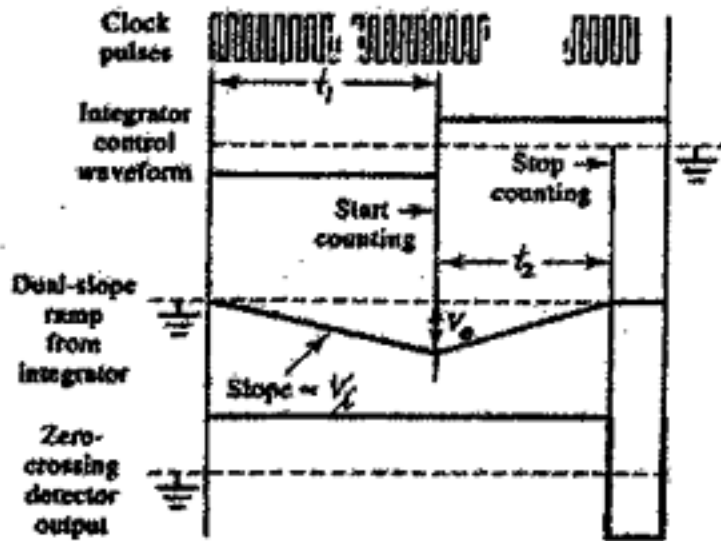

System waveforms of the dual-slope-integrator
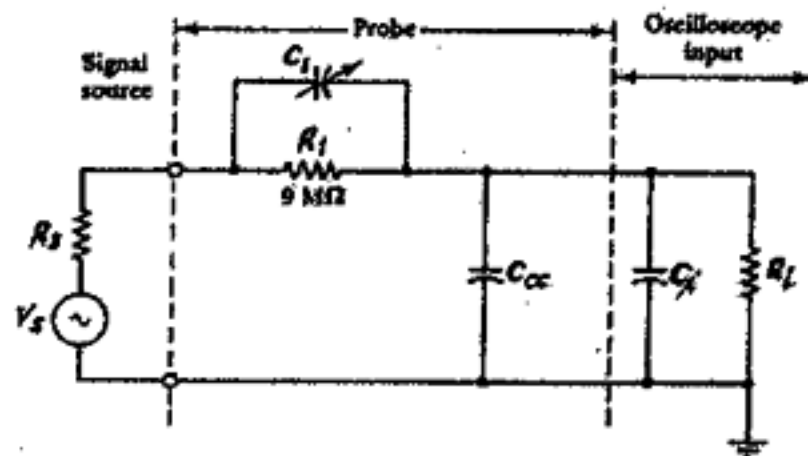ADC (problem 1)
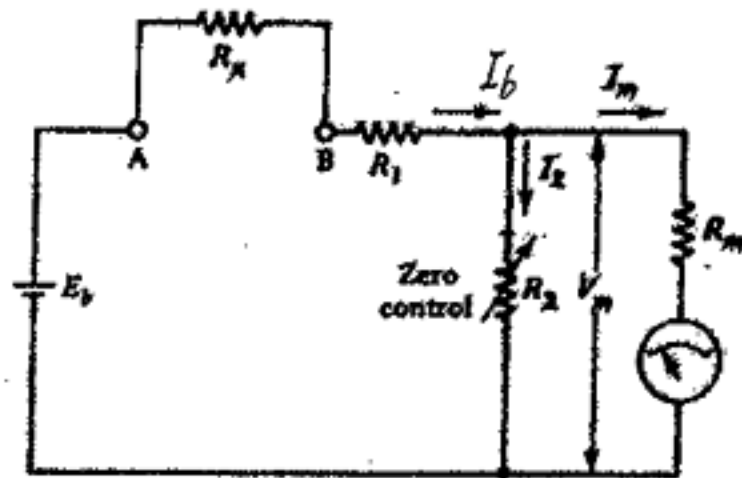
Series ohmmeter (problem 3)

4. **(15%)** Find the series-equivalent inductance and resistance of the network (coil) that causes a bridge (as shown below) to null with the following component values: ω=3000 rad/s, R_2=10 kΩ, R_1=2 kΩ, R_3=1 kΩ, C_1=1 μF. Also, determine the Q factor of the coil

5. **(15%)** Determine the dimensions of *magnetic flux* (ϕ), *inductance (L)*, *resistance (R)*, and *capacitance (C)*. Using the results to show that the product of R and C has a time unit.

6. **(10%)** Sketch half-wave rectifier ac electronic voltmeters using (a) a voltage follower and (b) a precision rectifier. Explain the operation of each circuit, and compare their performance.

7. **(15%)** A 10:1 oscilloscope probe, as shown below, is used with an oscilloscope with $R_i = 1$ MΩ and $C_i = 40$ pF. If the probe uses a 9 MΩ series resistor and the coaxial cable has a capacitance of 80 pF, determine the value of capacitor C_1 that should be connected in parallel with the 9 MΩ resistor. Also calculate the signal frequency at which this probe will produce a 3 dB reduction in signal from a 1 kΩ source.
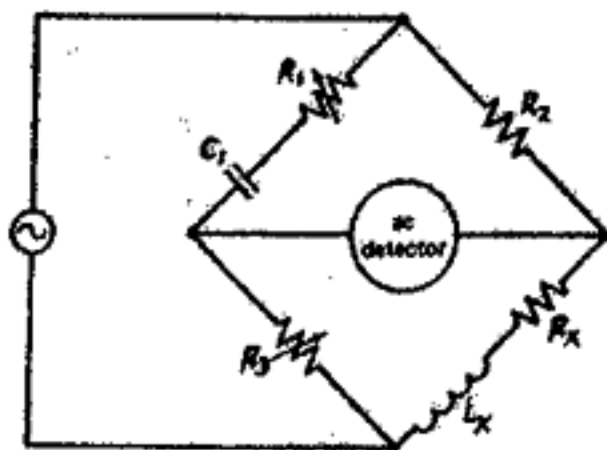
A bridge (problem 4)

Circuit of 10:1 probe (problem 7)