AML 130 Experimental Methods and Analysis 3-1-2) **Major Test** Time 2 hrs. 1-12-2007

1 Given the following data, use least squares to find a linear equation that best fits the data:

x =	1	2	3	4	5	6	7	8	9	10
y =	5	8	8	9	10	10	10	12	13	13

What is the correct expression for the standard error of a volume where two of the three sides have the same mean and standard error?

2 A spot speed check was made on a main city street to determine the average speed of drivers, with the results $\bar{x} = 31$ *kmph*, n = 100, and $\sigma_s = 2$ *kmph*. Using a 95 percent confidence limit, Is it possible that the average speed could actually be as low as 30 *kmph* (the posted speed limit)?

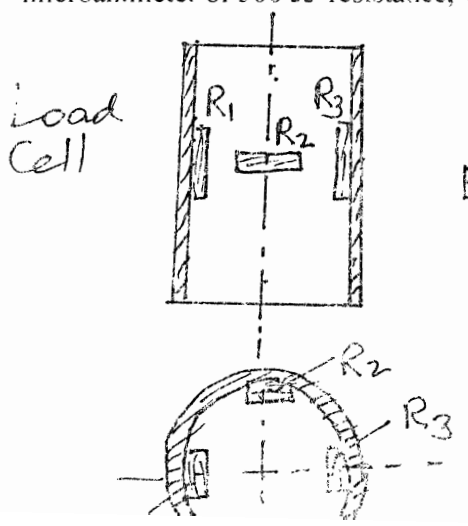
3 A venturi tube is to be used to measure a maximum flow rate of 227.30 *litres/minute* (*lpm*) at 21°*C*. The throat Reynolds number is to be at least 10^5 at these flow conditions. A differential pressure gage is selected which has an accuracy of 0.25 % of full scale.
Determine the size of the venturi and the maximum range of the differential pressure gage and estimate the uncertainty in the mass flow measurement at nominal flow rates of 227.30 *lpm* and 113.65 *lpm*. Assume discharge coefficient to be as 0.976. Take viscosity of water as 0.001 Ns/m^2 at 21°C.

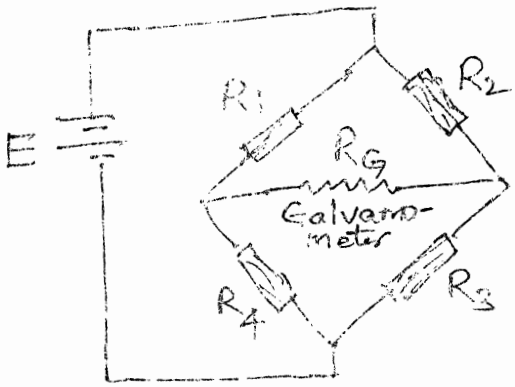
4 Derive the dynamic characteristics equation of piezo-electric translusors given by $e_o = K A \exp(-t/\tau)$, where pulse input magnitude is A, for time range 0 to T (Time period). K is voltage sensitivity constant.

5 Show that a square wave input signal can be expressed by $x_i = (4C/n\pi) \sin(2\pi nt/T)$ where n is odd natural number. What will be the corresponding output signal for a first order system?

6 a) What are various flow measurement techniques? Explain functioning of a Pitot-static tube
b) Give principle of working of a LVDT
c) What are various pressure measurement devices? How sensitivity of U-tube manometer can be increased?

7 A load cell is formed of a hollow steel cylinder loaded axially. The gauges are so connected as to enhance the signal and compensate for temperature variation. The load cell has a cross sectional area of 2 cm^2. Youngs modulus of steel is 2.07 x 10^{11} N/m^2 and Poisson's ratio 0.3. Strain gauge resistance = 1000 Ω, Gauge factor = 2.1. The current in each strain gauge is limited to 20 *mA*.
Calculate (a) the bridge supply voltage and (b) the current in the detector arm if this consists of a microammeter of 500 Ω resistance, when the load cell is subjected to a force of 10^5 *N*.





R_1, R_2, R_3, R_4 Strain Gauges.