Department of Applied Mechanics
MAJOR TEST
AML - 130 Experimental Methods & Analysis

Date 30/11/06   Max Marks - 60
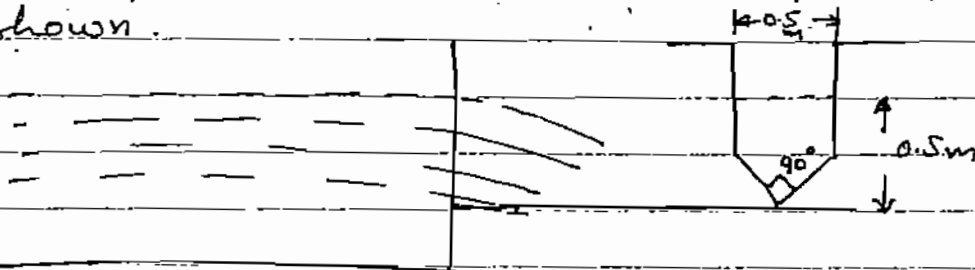Time - 2 hrs   8 - 10 Am
Note : Attempt all Questions.

Q1a Water is flowing out from the opening in the vertical side of a large tank. The shape of the opening is as shown.

The water is freely discharging from the opening. If the height of Water above the vertex is 0·5 m. Calculate the rate of flow assuming $C_d = 0.65$ (5)

(Important relations $Q_{vnotch} = \frac{8}{15} C_d \tan \theta/2 \sqrt{2g} \, H^{5/2}$,

$Q_{weir} = \frac{2}{3} C_d \sqrt{2g} \, H^{3/2} \cdot b$)

Q1b. Design an Annubar with six holes on the front face with only one hole on the back face. The distance of the hole close to the symmetric axis is located at 17mm

                                                            (5)

Q2a. Derive the relations of amplitude ratio and phase difference for a 2nd order system with harmonic input Explain with figures.   (6)

Q2b. A thermometer with a time constant $\tau = 0.5$ secs initially reading zero is suddenly dipped in a hot water bath maintained at a temperature of 80°C. Derive the expression for the reading of the thermometer as a function of time. Also calculate the time required for a dynamic error to

Q2c. Explain the procedure for analysing Periodic input which is a non harmonic with an Example. (4)

Q3a. A shell is fired from a cannon with an initial velocity of V_0 at an inclination of 'α' to the horizontal. The distance 'L' at which the shell strikes the ground is given by

$$L = \frac{V_0^2 \, Sin\, 2\alpha}{g}$$

where g is acceleration due to gravity. The following data is given $V_0 = (500 \pm 0.5)\, m/s$; $\alpha = (30 \pm 0.2)^\circ$ and $g = 9.81\, m/s^2$ (exact). Calculate the value of 'L' as well as its error (7)

Q3b. The pressure of fluid is observed to rise with time as follows

t (secs)	0	1	2	3	4	5	6
p (kg/cm²)	0	0.2	0.45	0.6	0.7	0.9	1.2

Determine the average rate of rise of pressure and the best estimate of the pressure at t = 6 secs using the method of least squares. (8)

Q4. Briefly explain the working of the following Instruments
(i) Pneumatic displacement Gauge
(ii) Optical Method of measuring displacement
(iii) Optical pyrometer
(iv) Reynolds stresses by Laser Doppler Anemometer
(v) Vortex flow meter (15)

Q5. A three hole probe is used to measure air velocity in 2D plane. The ΔH measured is 20mm at an angle of 30° with the horizontal. What is the velocity vector if the following data is given ($\rho_{air} = 1.225\, kg/m^3$; $\rho_{H_2O} = 1000\, kg/m^3$)

ΔH Std Probe =	7.5mm	14.8mm	22.7mm	30.4mm	44.7mm
ΔH TH Probe =	5 mm	10 mm	15 mm	20mm	30mm

The probe constant for standard probe is 0.98 (5)