Mid Exam

The UNIVERSITY of JORDAN
FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
Engineering Measurement Lab (0904424)
Mid Exam, Second Semester, 2013-2014
Dr. Jehad A. A. Yamin   Date: 15-05-2014   Time: 100 minutes.

Name: ....   Univ. Roll No. : .

DO NOT USE ABBREVIATIONS IN YOUR ANSWER
EXPLAIN EACH STEP OF YOUR CALCULATIONS

Q1) A measuring machine bed was tested for straightness using certain device and gave the readings as shown in the table below.
1) Construct a profile graph of the surface relative to the initial line,
2) Calculate the out-of straightness for this surface and its location. Use <u>line joining end points</u> method.
3) Explain how in the experiment the angle of the line is found. Use suitable sketches.
4) What is the name of the device used in this experiment? Is there any other method by which the surface straightness can be measured?

(10 Marks)

Position mm	Angle Reading (Sec)
0	
100.000	507.000
200.000	433.000
300.000	350.800
400.000	287.000

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Q2) State in which experiment you used the following devices and state their function:

(10 Marks)

1) Bob or Float. Flow measurement, it yields the height of the rotameter
2) Orifice plate. Flow measurement, used to calibration by finding the discharge coefficient of the orifice plate
3) Piezometer. Flow measurement, used to find the pressure at various points
4) Prism. surface straightness, used to reflect the light from the lighting source
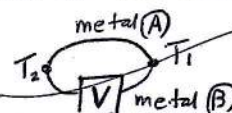5) Carriage. surface straightness, used to carry the mirror

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Q3) Based on thermocouple measurement experiment.   **(10 Marks)**

1) What is the principle of thermocouple operation?
2) State and discuss Law of Intermediate Metals. Use suitable sketches.

① any two dissimilar metals with two different temperatures at the terminals yields small voltage which can be measured by a voltmeter

②

Q4) Based on the Flow Measurement Experiment the following data was observed:

(10 Marks)

Given Data:

Pipe inlet diameter [for the venturi = 30mm;   for orifice plate = 50mm].

Throat diameter   [for Venturi = 20mm;   for Orifice plate = 25mm].

Dynamic viscosity of water is 1.08×10^{-3} N-s/m^2.   Water density = 1000 kg/m^3

Observed Data:

The manometers levels (in mm H$_2$O) were as follows:

Venturi inlet = 200mm,   Venturi throat = 115mm

Orifice inlet = 250mm,   Orifice throat = 150mm.

Float height for the rotamter = 20.05cm.

Time needed to collect 7.5kg of water was 16.75 seconds.

Calculate using the equation sheet and Figure above, the following:

1. The discharge coefficient for both venturi and orifice plate. Comment of your results?
2. The flow rate indicated by the rotameter.
3. **The Reynolds number at the throat for both obstruction flow devices.**
4. **Calculate the error in flow rate measurement of each one of the three devices** as value and percentage of true value.
5. State THREE possible sources of errors in this experiment.

Bob or float / Flow measurement, used to determine the flow rate using the rotameter

Orifice plate / Flow measurement, used to create the required differential pressure to measure the flow rate

Piezometer / Flow measurement, used to find the static pressure of the flow at inlet and exit of device

Prism / surface straightness, used to send the wire image to the mirror of the carriage and also to calculate the reflected angle by changing the incident angle

Carriage / surface straightness, contains the mirror needed to reflect the wire image between the lines on the screen for angle measurement

Ans Final Q4

Water

Density =	1000	kg/m^3
Dynamic Viscosity =	1.08E-03	N-s/m^2
Mass Collected =	7.5	kg
Time for Collection =	16.75	s
Actual Mass Flow Rate =	0.4477761	kg/s

Rotameter

Height =	20.05	cm
Curve Fit Equation =	0.451	kg/s
Error =	-0.00324	kg/s
Percentage Error =	-0.72333	%

Venturi

Inlet Pipe Dia =	30	mm
Throat Dia =	20	mm
Inlet Piezometer Height =	200	mm
Throat Piezometer Height =	115	mm
Theoretical Throat Velocity Throat =	1.44160007	m/s
Theoretical Mass Flow Rate =	0.45289202	kg/s
Discharge Coefficient =	0.98867097	
Reynolds' Number =	26393.85	
Error =	-0.0051308	kg/s
Percentage Error =	-1.1458844	%

Orifice

Inlet Pipe Dia =	50	mm
Throat Dia =	25	mm
Inlet Piezometer Height =	250	mm
Throat Piezometr Height =	150	mm
Theoretical Throat Velocity Throat =	1.446651	m/s
Theoretical Mass Flow Rate =	0.710123	kg/s
Discharge Coefficient =	0.63054	
Reynolds' Number =	211115.08	
Error =	-0.262362	kg/s
Percentage Error =	-58.5942	%

Question (1)

Conversion Factor = 0.5 micrometer for one SECOND

Line Joining End Points

Position	Angle Reading (Sec)	Difference from first Reading (Sec)	Rise/Fall in interval length "l" (micro m)	Cumulative Rise/Fall wrt line ab (micro m)	Line Joining End Points	Difference C6-C5
A	0.00	0.00	0.00	0.00	0.00	0	0.000
B	100.00	507.00	0.00	0.00	0.00	56.275	56.275
C	200.00	433.00	74.00	37.00	37.00	112.55	75.550
D	300.00	350.80	156.20	78.10	115.10	168.825	53.725
E	400.00	287.00	220.00	110.00	225.10	225.1	0.000
							Out-of-Straightness

Slope = 0.56275   Intercept = 0
h = 0.50

Cumulative Rise/Fall wrt line ab (micro m) vs Positition (mm)

— Cumulative Rise/Fall wrt line ab (micro m)
- - - Line Joining End Points

MECHFAMILY