Major Test

30 Nov. 2006, 10:30-12:30 Marks 20

1. In the flow visualization experiment you had obtained pictures with potassium permanganate and lycopodium powder. Which of these images, if any, can be used as an input to PIV image processing system to get the velocity field? Explain briefly and indicate how camera settings would affect the process. [2]

2. A 4-20 mA signal is output by a differential pressure transducer which is digitized by an 8-bit A/D converter. The transducer is calibrated for an operating range of 0-10 bar. In steady state conditions, the output bits of the transducer (in decimals) were: [3]

   89, 91, 90, 88, 92, 88, 87, 90, 89, 81, 89, 90, 92, 91, 90

   (a) What is the interval estimate for the differential pressure (in kPa)?
   (b) What is the uncertainty (in bar) associated with the digitization process?
   (c) How will you interpret an output represented by 255 (decimal)?

3. Consider the natural convection experiment. A student says "Let us remove the thermocouples and measure the temperature with the IR thermometer." Examine the feasibility of this suggestion if (a) plate emissivity is known to be more than 0.96, and (b) plate emissivity is not known. [2]

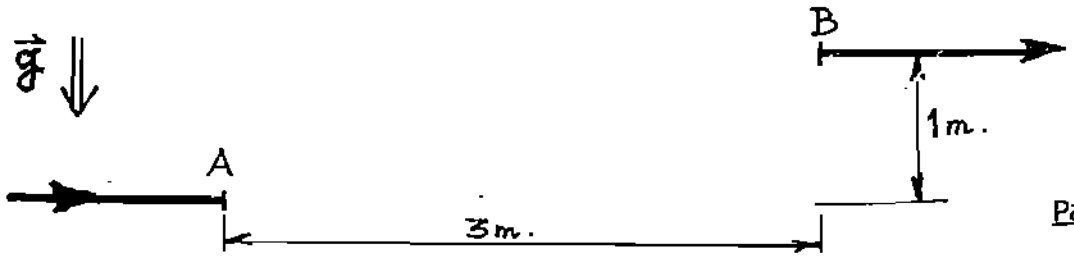
4. Explain with a sketch, the salient features of the shadowgraph, Schlieren and interferometer techniques. [2]

5. The pressure and temperature of superheated R-134a are measured as 100 ± 5 °C and 900 ± 50 kPa, both at 99 % confidence level. Estimate the uncertainty in the specific enthalpy and indicate the corresponding confidence level. Specific enthalpy in $kJ \cdot kg^{-1}$ are given below: Among pressure or temperature, which one should be measured with more care? Give brief reasons. [2]

	850 kPa	**900 kPa**	**950 kPa**
95 °C	479.8	479.2	478.6
100 °C	484.9	484.3	483.6
105 °C	490.1	489.5	489.0

6. In a hot wire anemometer, the current and voltage are each measured with ± 1 % uncertainty. Uncertainty in wire and air temperature difference is ± 2 %, and in wire diameter and length ± 5 and ± 2 %, respectively. What is the uncertainty in heat transfer coefficient, and in velocity assuming King's law for constant temperature operation? [3]

7. An engineer needs to install a rotameter and a vortex shedding flowmeter in parallel between two terminal points A and B, shown below (in the plane of the paper). Pipe nominal diameter is 200 mm. Isloating valves are needed before and after each flow-meter. Make a dimensional sketch for this purpose. [3]



M.E.Dept.,IITD.
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MEL705 Experimental Methods for Thermal Engineering

Entry No

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8. Discuss the salient features of the flow visualization picture below. [3]
Visualization is by air bubbles in water. For point-wise measurements of u- and v- components, what instrument(s) would you recommend and why?
Answer on this sheet and attach it to the answer book.