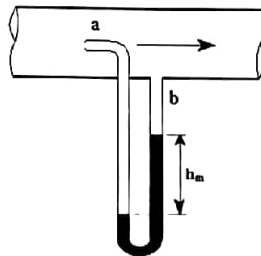


**Exam, five (5) exercises.**

1. Explain *briefly* the following concepts
  - a. Bourdon tube
  - b. Uncertainty
  - c. Sensitivity
  - d. LVDT (linear variable differential transformer)
  - e. Piezoresistive effect
  - f. Photomultiplier tube
2. Explain:
  - a. The difference between radiometry and photometry (also in terms of measurement equipment).
  - b. The operating principle of capacitive sensors. Give two examples for different measurement quantities.
3. Which phenomenon is the optical temperature measurement based on? Define the term emissivity and describe how should it be taken into account when measuring the temperature of an object optically?
4. The velocity of air is measured using a pitot tube based on a mercury manometer (Figure 1). What is the velocity, if  $h_m = 6$  cm? Densities of mercury and air are  $13,6 \text{ g/cm}^3$  and  $1,2 \text{ kg/m}^3$ , respectively.



**Figure 1.**  
Pitot tube  
based on a  
mercury  
manometer

5. A cylinder shaped NTC thermistor ( $R_0 = 10 \text{ k}\Omega$  at  $25^\circ\text{C}$ ,  $\beta_0 = 3988 \text{ K}$  at  $25^\circ\text{C}$ ,  $\gamma = +2.679 \text{ K/K}$ , diameter  $d_s = 2.9 \text{ mm}$  and length  $l_s = 4 \text{ mm}$ ) is set in a cylinder shaped hole in anodized aluminium (diameter  $d_H = 3.4 \text{ mm}$ , depth  $l_H > l_s$ ). Calculate the resistance of the thermistor at  $50^\circ\text{C}$ . Determine the self-heating at the same temperature when the measuring current is  $1 \text{ mA}$  and the hole is filled with silicon paste with the thermal conductivity  $k_{\text{Si}} = 149 \text{ W m}^{-1} \text{ K}^{-1}$  or air with the thermal conductivity  $k_{\text{air}} = 0.026 \text{ W m}^{-1} \text{ K}^{-1}$ .