Sheet 1.

1. Sensitivity is the smallest fractional change in a device that can be measured.

2. The accuracy is ~~test~~ the ratio $\frac{\Delta A}{A}$ where A = fullscale reading of the device.
The precision is ~~it~~ ratio $\frac{\Delta P}{P}$ where P is the measurement of the difference between two scale points.

3. An active sensor requires a source of power.
A passive sensor ~~requi~~ does not require a source of power.

4. Yes. A transducer convents a ~~mechanical~~ physical property to an electrical signal and ~~the~~ an ~~electr~~ equivalent electrical signal to a physical property.

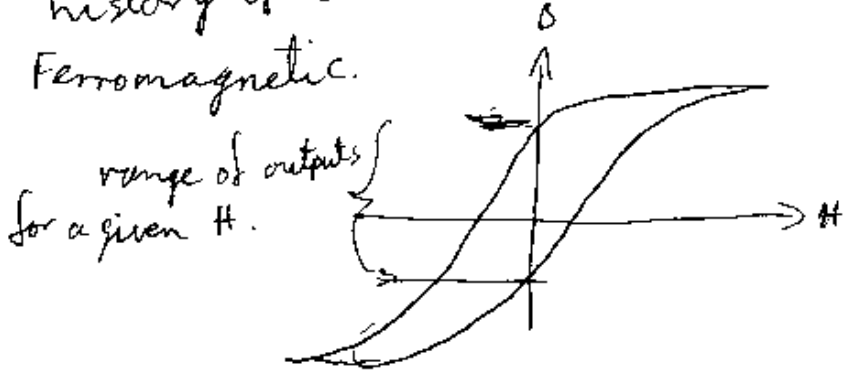
5. A sensor just convents a physical property to an electrical signal.
Transducer: Piezoelectric ~~Ultra~~ - Sonic transmitter / receiver.
Sensor: Thermister resistor.

5. It is characterized with a time constant τ and the formula:

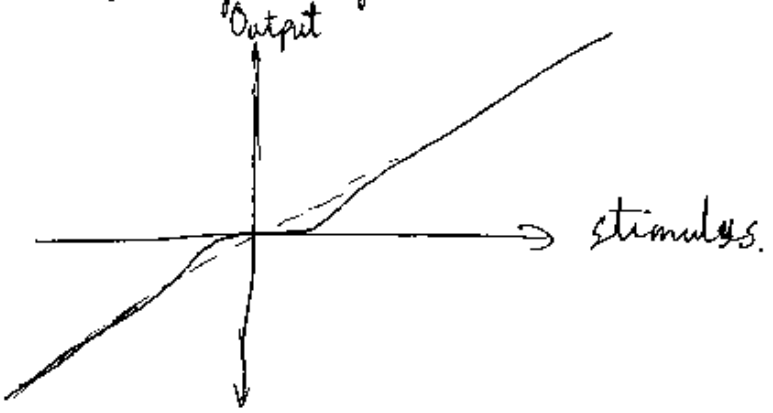
$$S = S_m(1 - \exp(-\frac{t}{\tau}))$$; S_m = steady state output, t is time.

6. A good example is a GaN based U.V. sensor. Fast initial response but slow decay time.

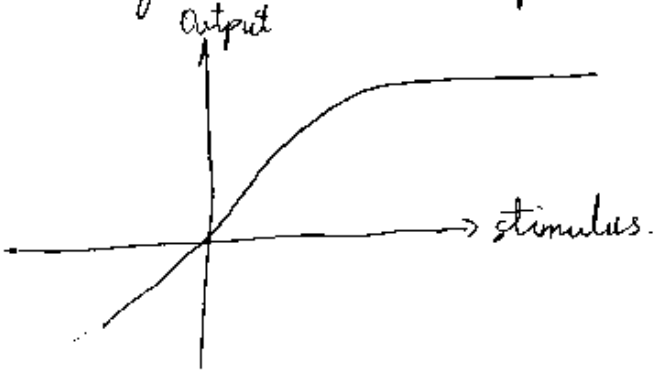
7. (a) Hysteresis: Output of a sensor depends on the history of the device. Classic example is the Ferromagnetic.



(b) Dead band a region of stimulus with no output.



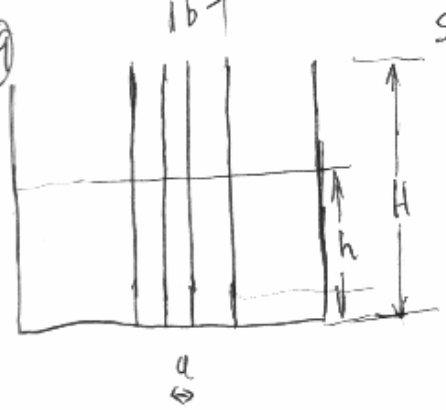
(c) Saturation. Maximum output achieved. Further increases in signal have no effect.



8. Temperature, pressure, humity, noise, vibration, chemical vapours, light, heat, UV, X-ray, Ionionizing radiation, vacuum.

Sheet 1 continued.

(9)



(a) $$C = \frac{2\varepsilon_0 (H - h(1-K))}{\log_e(\frac{b}{a})}$$

$$= \frac{2 \times 8.85 \times 10^{-12} (20 - 2(1 - 78.5))}{\log_e(\frac{2}{1})}$$

$$= 4.46 \times 10^{-9} \text{ Farads}$$

(b) $$C = \frac{2 \times 8.85 \times 10^{-12} \times 20}{0.69315} = 5.1071 \times 10^{-10} \text{ Farads.}$$

(c) This sensor makes a good measurement of water height. The capacitance increases linearly with water depth.

The sensitivity of the device is: $\frac{dC}{dh}$ or $\frac{\Delta C}{\Delta h}$

$$C = \frac{2\varepsilon_0(H - h(1-K))}{\log_e(\frac{b}{a})} = \frac{2\varepsilon_0 H - 2\varepsilon_0 h + 2\varepsilon_0 hK}{\log_e(\frac{b}{a})}$$

$$\frac{dC}{dh} = \frac{2\varepsilon_0 K}{\log_e(\frac{b}{a})}$$ - This is constant at all values of h.

(d) From the expression for sensitivity we can see the sensitivity is directly proportional to the dielectric constant of the fluid.

Oil with dielectric constant $K = 4.5$ which is 20 x less than water.