CMPE242
Spring2023
PART II

April 3rd (Monday)

Road map for the 2nd half of the Semester:

ITDT (Industrial IDT):

- ADC Data Validation → ① F.F.T. (Fast Fourier Transform)
- Analog Sensor interface Design.
  - ② Power Spectrum Technique.
  - ③ Hardware Architecture Aspects
  - Ion Selective Electrode Sensors
    - Many Applications in different Industry Sector.

Homework Extension Next Monday with Demo.

Project: Due the End of the Semester.

- Implementation (1/3) 33%
  - PID.
  - I2C Sensor
  - PWM motor Control
    - Pre-processing C.E.T.
    - ADC
- Research Part: (1/3)
  - ① P.P.T Presentation on State-of-the-Art Technology in the Embedded world.
  - ② Report (Guideline)
  - ③ Proposal (one page), Submit to the CANVAS. for Approval. — By Wednesday | Monday Next
- Demo & Presentation: (1/3) By the end of the Semester.

Example: for Analog ISE Sensor interface Design.

Ref:

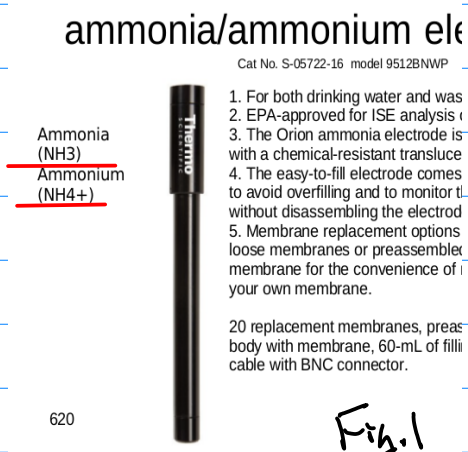
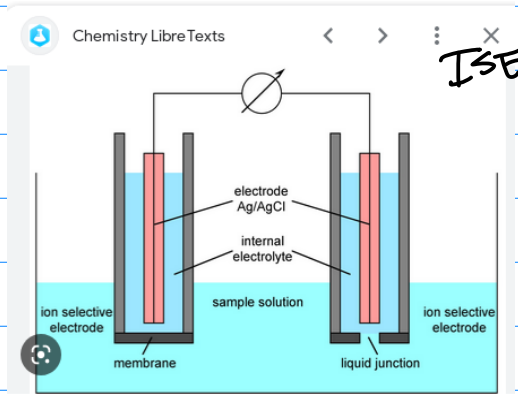




Fig.1

google Definition:

① Principle of ion-selective electrode (I.S.E.) An ideal I.S.E. consists of a thin membrane across which only the intended ion can be transported. The transport of ions from a high conc. to a low one through a selective binding with some sites within the membrane creates a potential difference.

→ Example of A Battery




ISE sensor

Fig.2

Working Principle of Battery - Electrical E... Visit

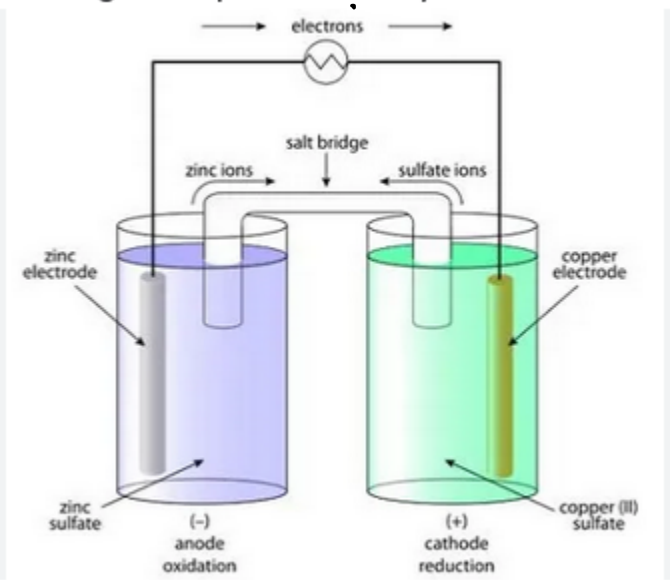



Fig. 3

Observation: Use Battery As An Example to Demonstrate Ion Selective Electrode Sensor. See $NH_3/NH_4^+$ sensor in Fig. 1.

Note 2: For the Non Linear Part, Let's perform Linearization — By using Piece-wise Linear Lines.

{ Piece-wise Line 1.
Piece-wise Line 2.

Next Step is to formulate Each Line by using Linear Equation.

$$\frac{y_2-y_1}{x_2-x_1}=\frac{y-y_1}{x-x_1} \quad \ldots (1)$$

Solve for $y=bx+c$ (see the previous Notes).

With Simplification By Removing Very Low Concentration Part, we have

Characteristic

Typical NH3 Calibration Curve

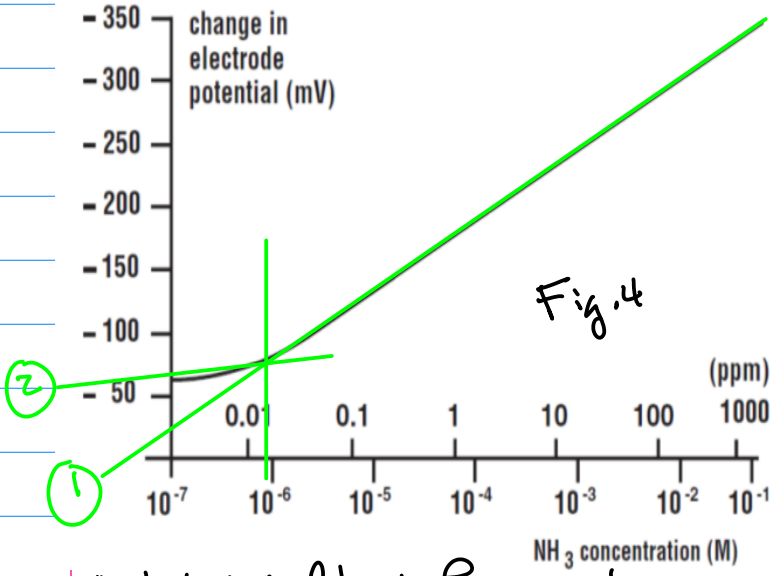



Fig. 4

Note 1. We like to have the Linear Characteristics from the Calibration Curve, such as [1,10], [10,100], [100,1000], etc.

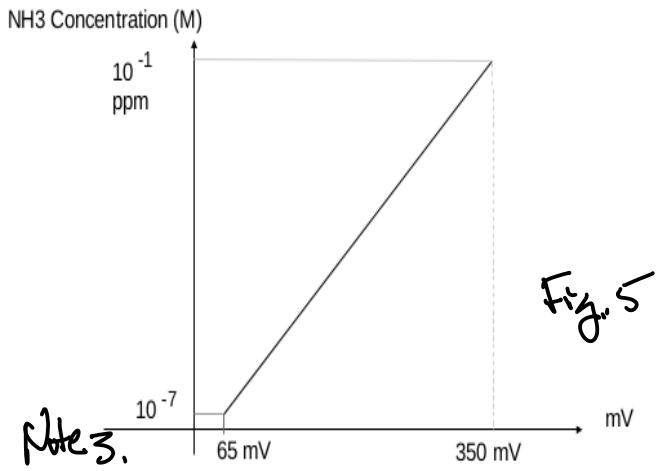



Fig. 5

Note 3. Then, Change the Cal-Curve to the Characteristic Curve e.g. Horizontal Axis is voltage for the Design of interface.

Industrial Analog Sensor
Interface Protocol :
1° Output has to be defined by Current. 2° The Range 4~20mA.

Control.com
https://control.com › Technical Articles

Why is 4-20 mA Current Used for Industrial Analog Sensors?

Note 4. Fit to the Dynamic Range of your target platform.
↓
External ADC Needed
CMOS Range ADC [0, 3.3]
TTL " " [0, 5.0]