Module 5 Unit 3
Magnetic Sensors

Sensing Magnetic Field

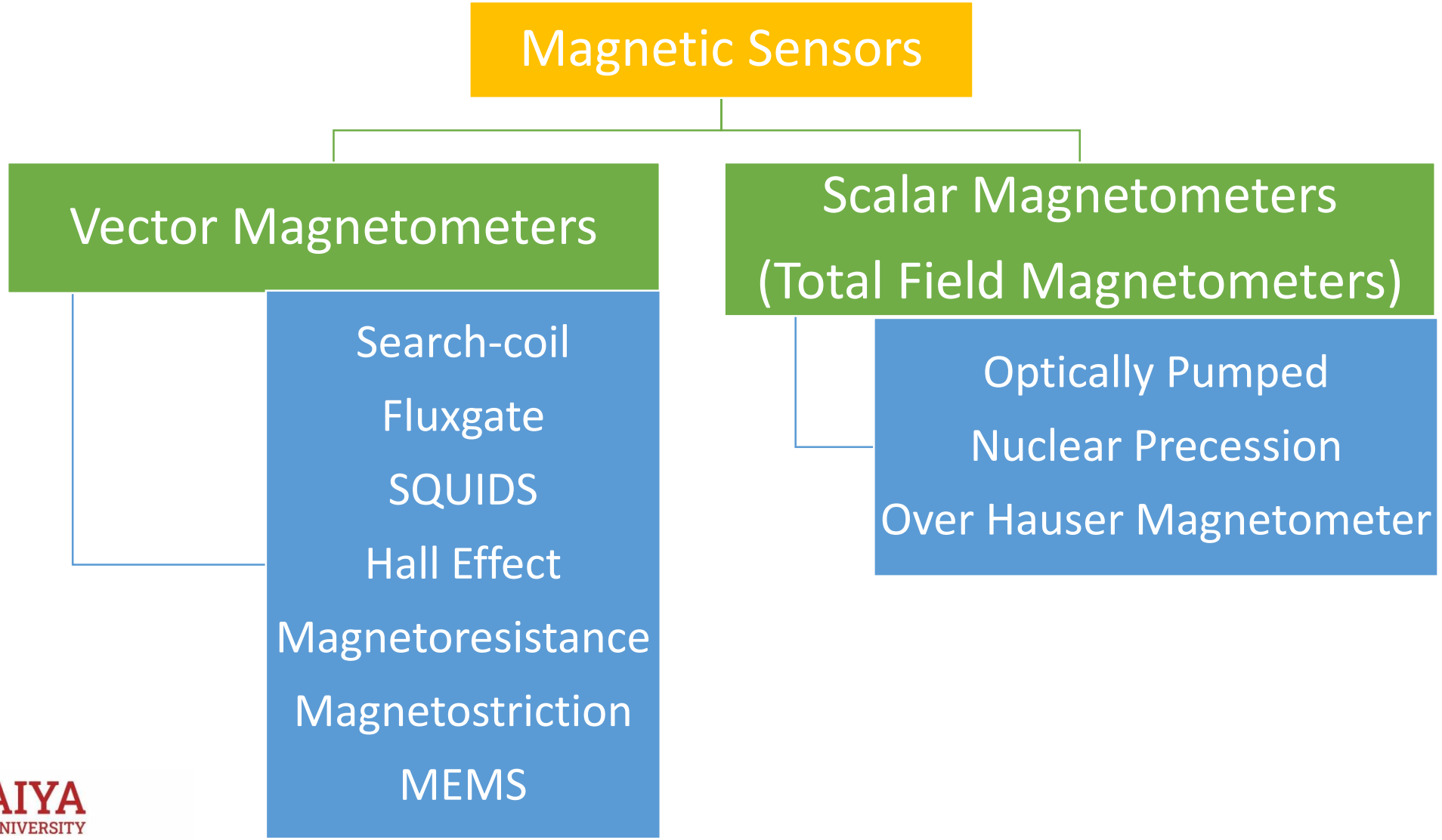
- Magnetic field sensors or magnetic sensors are transducers, which detect the magnitude of magnetic field in a region or each of its components
- Mainly based on link between electric current and magnetic field
- Main noise is the Earth's magnetic field. Typically 30-40 μT

Low field/High sensitivity: 0.1 nT or lower

Earth-Field/Medium sensitivity: 0.1 nT-100 μT

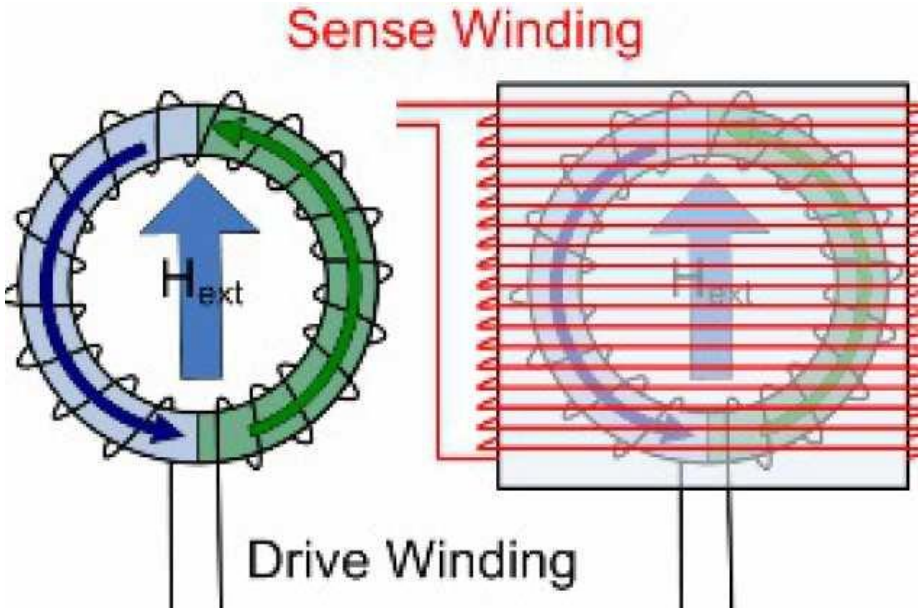
Bias Field/Low sensitivity: above 100 μT

Types of Magnetometers

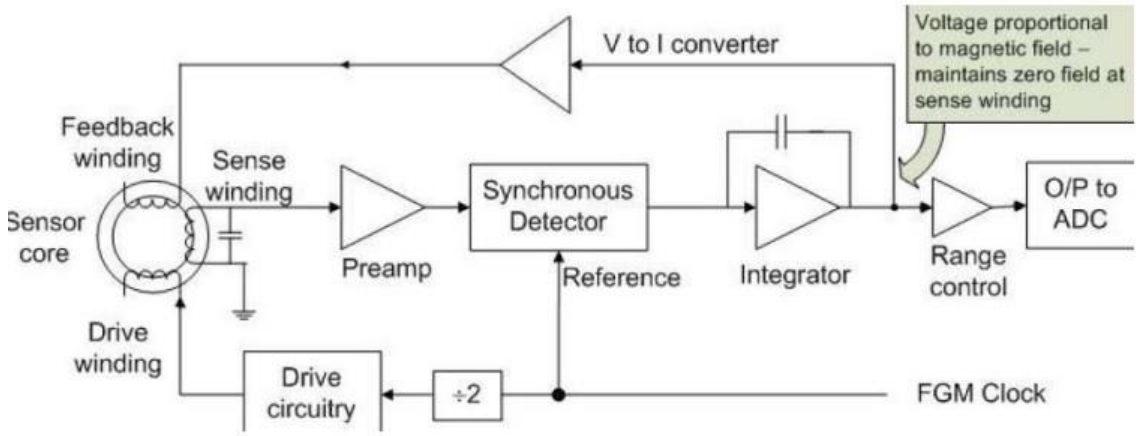


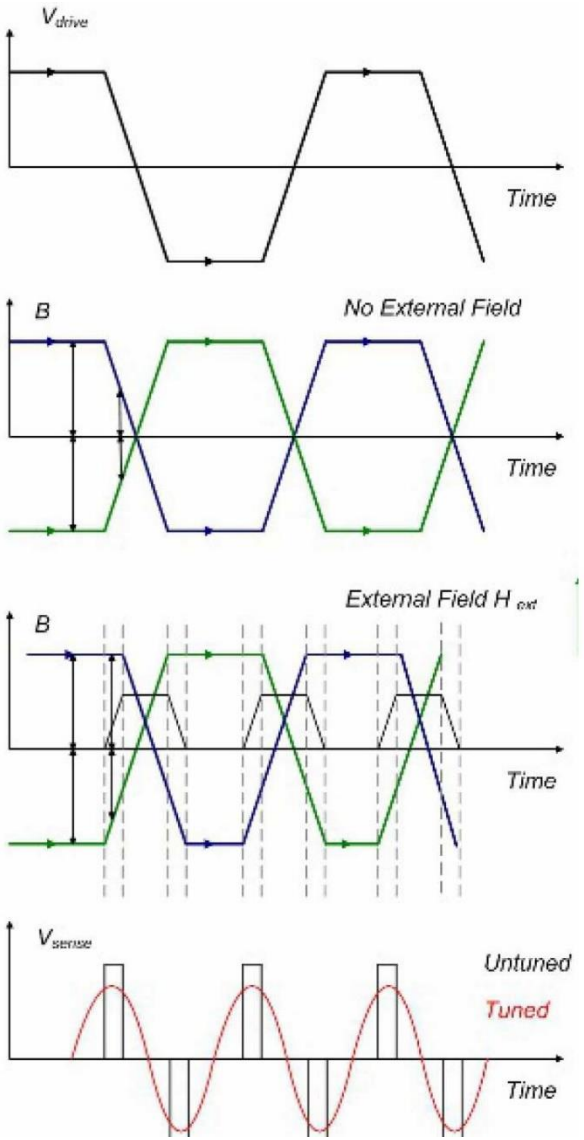
Fluxgate Magnetometer

- Based on electromagnetic induction (EMI)
- Driver coil operates the ferromagnetic core in to saturation
- Sensor coil is used to detect the change in current due to external field
- Sensitivity can be as low as 10^{-2} nT



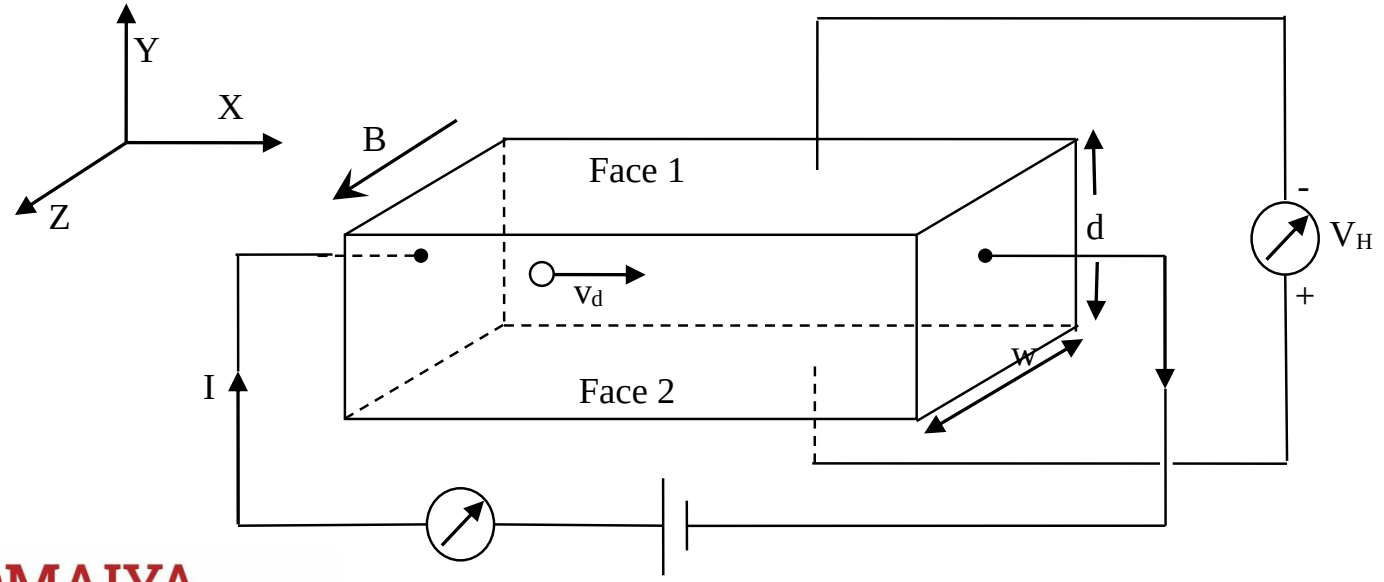
Fluxgate – Circuit and Waveforms





Hall Effect Sensor

- Based on Lorentz force
- DC current is setup in a semiconductor thin film
- Magnetic filed acting at right angles generates voltage called Hall Voltage



$$V_H = R_H \frac{I.B.d}{A};$$

$$R_H = \frac{1}{qp} \text{ or } \frac{1}{qn}$$

(Hall coefficient)

Magnetoresistance

- Change in length/strain caused by magnetic field
- Electrons take longer (circular) path and scatter more
- Increased scattering = increased resistance

$$R \propto B^2$$ For small fields

$$R \propto B$$ For very high fields