# Volume Measurement and Concentration Measurement

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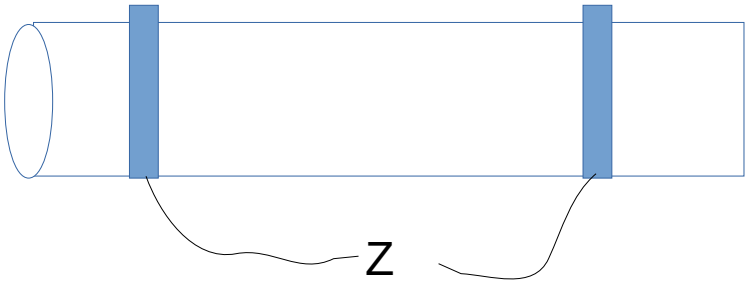
# Lecture - Outline

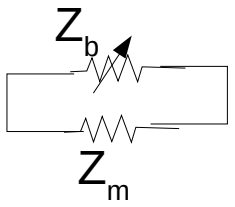
- Volume –
  - Electrical Impedance
  - Optical Absorption
- Optical density measurement
  - Absorption by chemicals
- Characteristics of Spatial Sensors
  - Spatial Transmission/Reception Pattern
- Chromatic measurement - spectrometry
  - Electrical
  - Optical
- Spectrophotometric oximetry

# Electrical Impedance Plethysmography

$$\Delta Z_b = \frac{\rho_b L}{\Delta A}$$

$$\Delta V = L \Delta A = \frac{\rho_b L^2}{\Delta Z_b}$$



# Impedance Measurement – 2 electrode, 4 electrode

- Constant current source
- Voltage measurement across electrodes
- 2 electrode method
  - Electrode-tissue impedance is included
- 4 electrode method
  - Inject current across outer 2 electrodes
  - Measure voltage across inner 2 electrodes
  - If amplifier has high input impedance
    - Electrode impedance is excluded

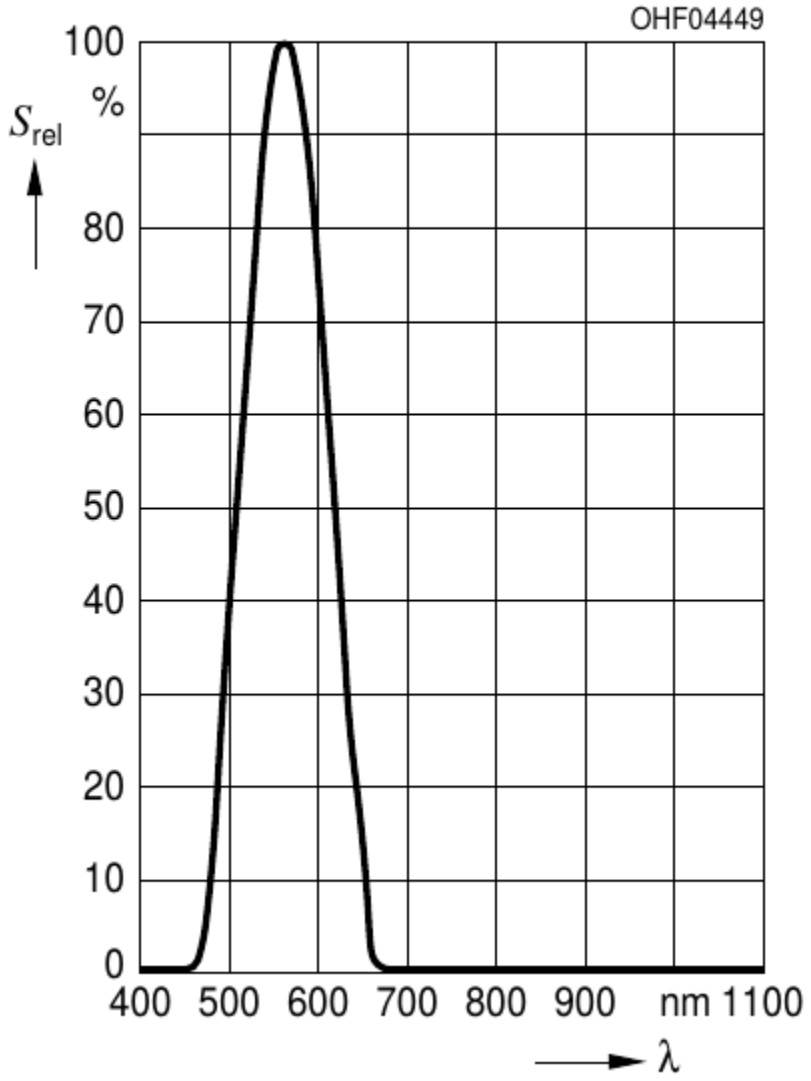
# Optical Emitters, Filters, Detectors

- Intensity is a function of frequency
  - Spectrum
- Spatial radiation, reception pattern
  - Angle dependent
  - Lenses and collimators
- Light transmission:
  - Incident energy = Transmitted+Scattered/reflected
- Transmission through multiple media
  - Snell's law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$

# Spectral characterisitics of Photodiode (SFH2270)

**Relative Spectral Sensitivity** 1) *page 11*

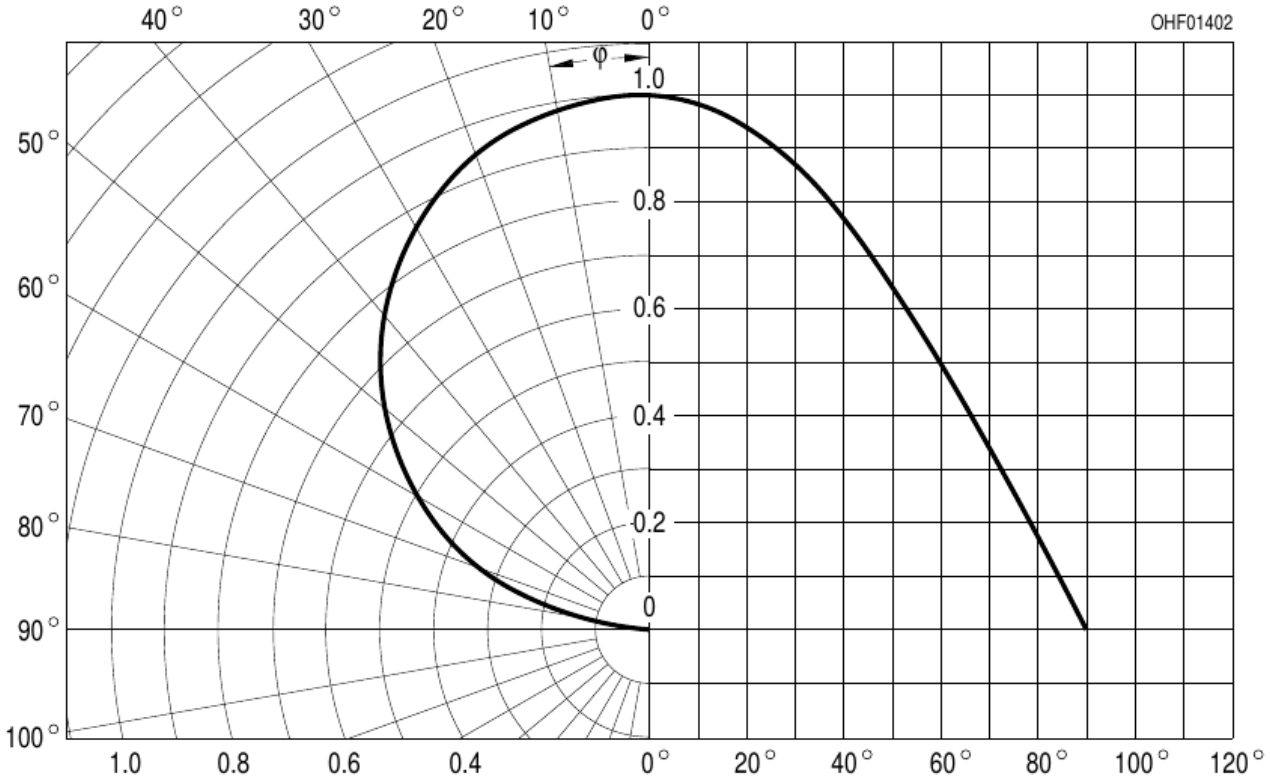
$S_{rel} = f(\lambda)$



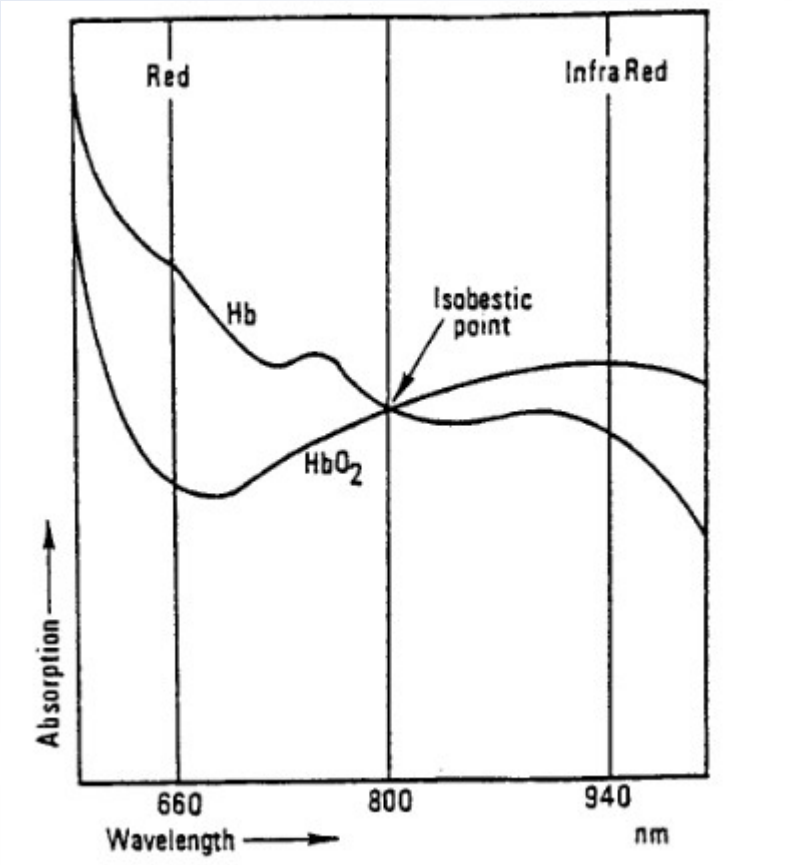
# Directional Characteristics

**Directional Characteristics** [1] *page 11*

$S_{rel} = f(\phi)$



# Spectrophotometry for Blood Oximetry



# Electrical Impedance Spectrometry

End of Lecture