國立臺北大學自然資源與環境管理研究所
110 學年度第一學期『環境工程科學概論』

課程講義(03)：物質與能量平衡、環境計量
Conservation of Material and Energy; Stoichiometry and Environmetrics

- INTRODUCTION – UNIFYING THEORIES
  - □ Conservation of Matter => Chemical Reactions (Bio-Sensor)
  - □ Conservation of Energy => Laws of Thermodynamics (Entropy)
  - □ Conservation of Matter and Energy => The Theory of Relativity ($E=MC^2$)

- MATERIAL BALANCE
  - □ Control Volume, Control Mass, and System
  - □ Steady State vs. Transit or Dynamic => Rate of Change => Sink/Source
    (Accumulation Rate) = (Input Rate) – (Output Rate) ± (Transformation Rate)
  - □ Steady-State Conservative Systems => Non-conservative Pollutants
  - □ Batch Systems with Non-Conservative Pollutants

- ENERGY BALANCE
  - □ First Law of Thermodynamics
    - ⇒ Thermal Unit of Energy; Specific Heat Capacity
    - ⇒ Latent Heat, Overheated Stream, Subcritical and Supercritical
    - ⇒ Pressurized Water Reactors (vs. Boiling Water Reactors)
  - □ Second Law of Thermodynamics
    - ⇒ Energy: Heat, Kinetic Energy, Potential, Electricity, etc.
    - ⇒ Work, Unusable Energy, Entropy and Disorderness/Randomness
    - ⇒ Thermal Efficiency: Carnot Engine => Fuel Cell
    - ⇒ Thermal Power Plants: Coal, Oil and Natural Gas; Combined Cycle
  - □ Conductive and Convective Heat Transfer
  - □ Radiant Heat Transfer
    - ⇒ Solar Energy: Heat vs. Photovoltaic
  - □ Heat Engine vs. Heat Pump

- UNIT OF MEASUREMENT
  - □ Basic Units: Length, Mass, Time, and Temperature
  - □ International System of Units (SI) vs. Imperial System (U.S. customary units)
  - □ Extended Units: Concentration, Dose, ppm(m), ppb(v), Energy, "Equivalent"
    - ⇒ Units for Air Pollutants: ppm(v), ppb(v), $\mu g/m^3$, iTEQ
    - ⇒ Units for Water Pollutants: mg/L, ppm(m), μ-mho/cm
    - ⇒ Units for Soil Contaminants: mg/kg, meq/100g (CEC)

- STOICHIOMETRY AND ENVIRONMETRICS
  - □ Chemical Reaction => Chemical Kinetics => Differential Equations
  - □ Statistical/Quantitative Methods => Environmental Informatics