

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

課程講義(五)：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
  - Conservation of Energy => Laws of Thermodynamics
  - Conservation of Matter and Energy => The Theory of Relativity
- MATERIAL BALANCE
  - Control Volume, Control Mass, and System
  - Steady State vs. Transit or Dynamic => Rate of Change  
(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 Disorder/Randomness
    - ⇒ Thermal Efficiency: Carnot Engine
    - ⇒ Thermal Power Plants: Coal, Oil and Natural Gas; Steam Generator and Internal combustion; Combined Cycle and IGCC
  - Conductive and Convective Heat Transfer
  - Radiant Heat Transfer
    - ⇒ Solar Energy: Heat vs. Photovoltaic
    - ⇒ Electromagnetic Spectrum: Wavelength vs. Frequency
  - 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),  $\mu\text{g}/\text{m}^3$ , iTEQ
  - Units for Water Pollutants: mg/L, ppm(m),  $\mu\text{-mho}/\text{cm}$
  - Units for Soil Contaminants: mg/kg, meq/100g (CEC)