

國立臺北大學自然資源與環境管理研究所

111 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 Disorder/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), $\mu\text{g}/\text{m}^3$, iTEQ
 - ⇒ Units for Water Pollutants: mg/L, ppm(m), $\mu\text{-mho}/\text{cm}$
 - ⇒ Units for Soil Contaminants: mg/kg, meq/100g (CEC)
- STOICHIOMETRY AND ENVIRONMETRICS
 - Chemical Reaction => Chemical Kinetics => Differential Equations
 - Statistical/Quantitative Methods => Environmental Informatics