

**Department of Civil and Environmental Engineering
Stanford University**

26 June 2017

CEE 70 – Environmental Science and Technology (Engr 90 Cross Listed)

- Time and Place:** Monday through Thursday 10:30 to 11:20, Y2E2 111
- Instructor:** Royal Kopperud
royalk@stanford.edu
- Teaching Assistants:** James Winter, Annie Yu
- Office Hours:** Y2E2, time and location to be announced
- Textbook:** Introduction to Environmental Engineering and Science, 3rd Edition, Prentice-Hall 2008, Gilbert M. Masters and Wendell P. Ela. Available at the bookstore and on reserve at the Engineering Library.
- Homework:** **20% of Final Grade** Homework sets handed out approximately weekly, due 1 week later. Homework is due before class begins and may be submitted in class or in the drop box at Y2E2 (Yellow Atrium Basement - Shelves).
- Although you may work together in groups of 2 or 3 to develop your understanding of the homework questions, your submitted homework must be a product of your own effort and must represent your own understanding.
Observe the Honor Code in preparing your homework.
- Exams:** **3 quizzes in class for 80% of Final Grade. 7/13/2017, 8/1/2017, and 8/17/2017. There will be no final exam.**
- Announcements:** Canvas course site. You should be automatically added to the site. Be sure to enable immediate notifications for announcements.

Topic Outline (Readings from IEES 3rd Ed.) Lecture Numbers are at the right.

Mass and Energy (pp. 1 - 35)1, 2, 3
 Ideal gas law
 Mass balances
 Steady-state
 First-order decay
 Energy balance
 Heat capacity and heat of vaporization
 Energy efficiency
Chemistry (pp. 47-70)4
 Stoichiometry
 Reaction enthalpy
 Equilibrium constants and pH
 Read and understand alpha-diagrams
Population Growth (Ch 3 especially pp. 87-94, 106-120)5
 Exponential growth
 Half life and doubling time
 Human population dynamics
Risk Assessment (Ch 4 especially pp. 145-157)6, 7
 Potency Factor or Oral Slope Factor
 Drinking water unit risk / Inhalation unit risk
 Drinking water equivalent level at 10^{-4} , 10^{-5} , and 10^{-6} risk
 Inhalation unit risk
 RfD, hazard quotient, and Hazard Index
Water Pollution (Ch 5, especially pp. 199-226, 229-240)8, 9
 Biochemical Oxygen Demand
 ThOD, BOD₅, CBOD, NBOD
 Rate constants and temperature dependence
 Streeter-Phelps oxygen sag curve
Lakes (pp. 219-226)10
 Algae and limiting nutrients
 Oligotrophic, mesotrophic, and eutrophic lakes
 Thermal stratification
Groundwater (pp. 229-244)11
 Porosity
 Hydraulic gradient
 Darcy's Law, Darcy velocity
 Average linear velocity and retardation
Water Quality (pp 289-295, 299-302, 314-332)12, 14
 Safe Drinking Water Act
 Maximum Contaminant Level (MCL) and MCL Goal (MCLG)
 Treatment Technique (TT)
 Secondary Standards
 Basic wastewater unit operations

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| Settling and Stoke's Law | |
| Settling basins | |
| Combined and separate sewer systems | |
| Reverse Osmosis (pp. 314-315 | 13 |
| Air Pollution (Skim pp. 367-384; 389-393; skim 394-426; 426-428; 437-438; 438-450; 450-458; 483-end of ch.7) | 15 through 19 |
| Criteria Pollutants | |
| Air Quality Index (AQI) | |
| Carbon monoxide | |
| Stokes Law | |
| Atmospheric stability | |
| Ozone | |
| Automobile pollution | |
| Gaussian dispersion | |
| Box model - steady state and transient solutions | |
| Global atmospheric change (Skim pp. 502-512; 512-536; skim 536-545; 545-551; 554- 558; 574-587) | 20, 21 |
| Energy balance and radiation | |
| IR window | |
| Albedo | |
| Climate sensitivity | |
| Global Warming Potential (GWP) | |
| Stabilization wedges | |
| Chlorine and stratospheric ozone | |