EK 335
Introduction to Environmental Engineering Science

Text
“Introduction to Environmental Engineering and Science”
by Gilbert M. Masters, Prentice Hall
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Course Grading

• Self-Study (Engineering Solutions to an Environmental Problem)
  – Oral Presentation (15 Minutes): 20%
  – Starts Feb. 2, two presentations per day

• Homework: 10%

• Test 1: 20% (Feb. 23, 2010)

• Test 2: 20% (March, 30, 2010)

• Final Exam: 30% (University Schedule)
<table>
<thead>
<tr>
<th>Student Name</th>
<th>Class</th>
<th>Presentation Dates</th>
</tr>
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<tbody>
<tr>
<td>Al-Husseini, Shoukry, Ishaq</td>
<td>Senior</td>
<td>2-Feb</td>
</tr>
<tr>
<td>Babaniyi, Olalekan, Adeoye</td>
<td>Senior</td>
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<td>Belmonte, Peter, Holland</td>
<td>Senior</td>
<td>4-Feb</td>
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<td>Bogoian, Jeffrey, Charles</td>
<td>Senior</td>
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<tr>
<td>Briggs, Kathryn, Elizabeth</td>
<td>Junior</td>
<td>1-Apr</td>
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<td>Burriola, Richard, Adam</td>
<td>Senior</td>
<td>9-Feb</td>
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<tr>
<td>Canham, Amy, Canham, Amy</td>
<td>Junior</td>
<td>1-Apr</td>
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<td>Chatham, James, Manning</td>
<td>Grad 1st</td>
<td>6-Apr</td>
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<td>Chin, Justin</td>
<td>Senior</td>
<td>9-Feb</td>
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<td>Docherty, Sean, Patrick</td>
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<td>Foley, Daniel, John</td>
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<td>11-Feb</td>
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<td>Going, Louisa, Marie</td>
<td>Soph</td>
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<td>Hathaway, Michael, Gerard</td>
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<td>Hulli, Leon Hulli, Leon</td>
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<td>Kocher, Sean, Petras</td>
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<td>Lynch, Brian, Robert</td>
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<td>13-Apr</td>
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<td>Magis-Agosta, Jesse, Daniel</td>
<td>Senior</td>
<td>25-Feb</td>
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<td>Marat, Yerzat</td>
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<tr>
<td>McDade, Daniel, Robert</td>
<td>Junior</td>
<td>13-Apr</td>
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<td>McDowell, Patrick, Robert</td>
<td>Senior</td>
<td>2-Mar</td>
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<td>Miklos, Laura, Yolanda</td>
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<td>Miller, Denise, Elizabeth</td>
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<td>Pyun, Joanna</td>
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<td>Uwilingiyimana, Jean, Bertrand</td>
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<td>Widzinski, Christopher, Edward</td>
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<td>Wolfson, Jill, Sarah</td>
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<td>23-Mar</td>
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<td>Wong, Tat, Chi Wong, Tat, Chi</td>
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<td>Senior</td>
<td>25-Mar</td>
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<tr>
<td>Xiao, Wen Xiao, Wen</td>
<td>Senior</td>
<td>25-Mar</td>
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</table>
Syllabus for EK 335: Introduction to Environmental Engineering Science

4 hours/week

1. Mass and Energy Transfer 1 week

2. Environmental Chemistry 1.5 weeks
   - Inorganic Chemistry
   - Organic Chemistry
   - Nuclear Chemistry

3. Growth Models 1 week
   - Resource Consumption
   - Population Growth
   - Economic Growth

4. Risk Assessment 1.5 weeks
   - Hazard Identification
   - Dose-Response Assessment
   - Exposure Assessment
   - Risk Characterization
   - Comparative Risk Analysis

5. Water Pollution 2.5 weeks
   - Water resources and pollutants
   - Oxygen demand
   - Pollutant transport
   - Water and waste water treatment
   - Legislations

6. Air Pollution 2.5 weeks
   - Emissions overview (industry, transportation, commercial and residential)
   - Legislations
   - Criteria and Toxic Air Pollutants
   - Pollution modelling
   - Pollution Control
   - Air pollution and Meteorology

7. Global Change 1 week
   - Greenhouse effect and global temperature
   - Carbon, nitrogen, and oxygen cycle
   - IPCC Emissions Scenarios
   - Oceanic changes and changes in the stratosphere

8. Solid Waste Management and Resource Recovery 2 weeks
   - Life-Cycle Assessment
   - Source Reduction including a discussion of the RoHS Directive
   - Collection and Transfer Operations
   - Recycling
   - Waste to Energy Conversion
   - Landfills

Control volume boundary

Accumulation

Reactions: Decay and generation

Inputs → Outputs

Figure: 01-01

Copyright © 2008 Pearson Prentice Hall, Inc.
Stream: $C_s, Q_s$

Wastes: $C_w, Q_w$

Accumulation = 0

Reaction = 0

$C_m, Q_m$ → Mixture

$Q =$ flow rate

$C =$ concentration of pollutant

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Control volume boundary

$C_s = 20.0 \text{ mg/L}$

$Q_s = 10.0 \text{ m}^3/\text{s}$

$C_w = 40.0 \text{ mg/L}$

$Q_w = 5.0 \text{ m}^3/\text{s}$

$C_m = ?$

$Q_m = ?$

Figure: 01-03

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Figure: 01-04

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$Q_w = 0.5 \text{ m}^3/\text{s}$
$C_w = 100.0 \text{ mg/L}$

$Q_s = 5.0 \text{ m}^3/\text{s}$
$C_s = 10.0 \text{ mg/L}$

$V = 10.0 \times 10^6 \text{ m}^3$
$k = 0.20/\text{day}$
$C = ?$

$C_m = ?$
$Q_m = ?$

Figure: 01-07

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Figure: 01-08

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Flow in $Q, C_i$

Control volume $V$
Concentration $C$

Decay coefficient $k_d$
Generation coefficient $k_g$

Flow out $Q, C$

Figure: 01-10

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The diagram illustrates a concentration curve over time, with the following equation:

\[ C_\infty = \frac{QC_i + k_g V}{Q + k_d V} \]

Where:
- \( C_\infty \) is the final concentration.
- \( Q \) is the flow rate.
- \( C_i \) is the initial concentration.
- \( k_g \) is the first-order rate constant for adsorption.
- \( k_d \) is the first-order rate constant for desorption.
- \( V \) is the volume of the system.

The graph shows the concentration decreasing over time from an initial concentration \( C_0 \) to a final concentration \( C_\infty \). The time axis is labeled as \( t \).

Figure: 01-11

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Figure 01-12

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Figure: 01-13

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Electrical output 1,000 MW\textsubscript{e}

Stack heat 300 MW\textsubscript{t}

Coal 3,000 MW\textsubscript{t}

Cooling water 1,700 MW\textsubscript{t}

\[ Q_c = 40.6 \text{ m}^3/\text{s} \]
\[ T_c = 30.0 \text{ °C} \]

Stream

\[ Q_s = 100.0 \text{ m}^3/\text{s} \]
\[ T_s = 20.0 \text{ °C} \]

\[ Q_s = 100.0 \text{ m}^3/\text{s} \]
\[ T_s = 24.1 \text{ °C} \]
Hot reservoir
$T_h$

$Q_h$ Heat to engine

Heat engine

$Q_c$ Waste heat

Cold reservoir
$T_c$

Work $W$

Figure: 01-15

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Figure: 01-16

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3 kWhr (10,800 kJ)
450 g coal (including: 280 g C, 45 g ash, 9 g S)

33.3% efficient power plant

1 kWhr electricity (3,600 kJ)

85% S, 99.5% particulate removal

To atmosphere
1.4 g S (2.8 g SO₂)
0.14 g fly ash
280 g C
1,080 kJ

31.36 g ash 7.6 g S to disposal

13.5 g bottom ash
6,120 kJ to cooling water

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Figure: 01-19

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Figure 01-21

Ultraviolet 7%
Visible 47%
Infrared 46%

Intensité (W/m²-µm)

Wavelength λ (µm)

Extraterrestrial solar flux
5,800-K Blackbody

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\[ \lambda_{\text{max}} = \frac{2.898}{T(K)} \]

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