CHEM 313 Environmental Chemistry Laboratory - Syllabus, Fall 2013

General Information:
The laboratory course meets every Tuesday from 10:00am to 1:50pm in FH 313. In total ten individual experiments are scheduled with one discussion session on October 15, 2013. We will use the discussion to talk about the experiments already done and the ones to be carried out during the remainder of the semester.
The students work on the experiments in groups of 3, but each student will submit a written lab report one week after completion of each lab. The dates and format of the lab reports are outlined below.
An introductory meeting is scheduled for August 27, 2013 to discuss the course procedure, check the lockers and obtain general safety instructions. Course materials will be provided either as hard copies, or as electronic copy via Sakai.

Objectives:
The course will help understanding of basic environmental principles and important environmental issues via selected experiments. Through these experiments laboratory and critical thinking skills will be acquired applicable to any environmental field. Team working skills will be fostered as well as writing laboratory reports.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Experimental work</th>
<th>Lab Report due date</th>
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</thead>
<tbody>
<tr>
<td>2) Chloride in natural waters</td>
<td>September 10, 2013</td>
<td>September 17, 2013</td>
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<tr>
<td>3) pH, buffer, conductivity in natural waters</td>
<td>September 17, 2013</td>
<td>September 24, 2013</td>
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<td>4) PAH’s in environmental samples</td>
<td>September 24, 2013</td>
<td>October 1, 2013</td>
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<td>5) Photolysis of iron</td>
<td>October 1, 2013</td>
<td>October 15, 2013</td>
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<tr>
<td>Break</td>
<td>October 8, 2013</td>
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<tr>
<td>Discussion</td>
<td>October 15, 2013</td>
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<tr>
<td>6) Air oxidation of metal ions</td>
<td>October 22, 2013</td>
<td>October 29, 2013</td>
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<td>7) Halogenated hydrocarbons and the ozone depletion</td>
<td>October 29, 2013</td>
<td>November 5, 2013</td>
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<td>8) Acid Mine Drainage</td>
<td>November 5, 2013</td>
<td>November 12, 2013</td>
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<tr>
<td>9) Removal of Nitric oxide by complex formation</td>
<td>November 12, 2013</td>
<td>November 19, 2013</td>
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<tr>
<td>Check out and final discussion</td>
<td>December 3, 2013</td>
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Laboratory Report Format

The lab report should include page numbers and be proofread before submission. It is also recommended to print reports double sided to save paper.

Each lab report should consist of:

a) Title page
   Should contain: title of report, name of student, name(s) of the other group members, name of the course, date of experiment, date of report.

b) Introduction
   Should include: brief description of the background of the experiment. For example, what are the reasons for the experiment performed, what species or property is measured and why, how does the instrument used work and what does it measure etc.

c) Experimental
   Should include:
   * Reagents and glassware used,
   * Apparatus used (manufacturer, model etc.)
   * Instrumental settings
   * Description of sample preparation procedure, standardization procedure
   All of this should be formulated in such way that somebody else will be able to perform the lab after reading this report.

d) Results
   Should include:
   * Raw Data (Organized in tables that are properly labeled. Should be clearly readable and understandable)
   * Sample calculations (one example calculation for each calculation procedure should be shown, including proper units and significant figures and explained). The sample calculation needs to be labeled (trial # used for example calculation). Calculations are to be typed, not handwritten!
   * Data calculated (also organized in tables and properly labeled)
   * Graphs and Figures (all graphs should be stand-alone and must be numbered, labeled properly and titled, provide a brief description for each graph/figure, linear regression should be used to obtain straight lines and the parameter must be included, this part should also include all spectra and/or chromatograms labeled and numbered properly). Handwritten graphs will not be accepted; use Excel or another graphing program to generate calibration curves, etc.

e) Discussion
   The discussion should refer to the range of data, whether the data are useful and make sense, what are the implications of the data, what kind of errors could be present and what is the
meaning of the data with respect to the sample analyzed.

f) Conclusions
   This should conclude the experiment with respect to importance of method, selectivity of instrumentation (maybe another method would be more appropriate?)

g) References
   All references used should be cited in accordance to the ACS published journal “Analytical Chemistry”.

The report style should be like in a peer reviewed paper with all pertinent information present. All sections of the report are to be clearly labeled. Despite data sharing as working in a group on the experiments, each student has to turn in his/her own report with own calculations, discussion, conclusion etc.

**Grading Scale for Lab Reports:**

Each lab report is worthy 100 points distributed in the following:

<table>
<thead>
<tr>
<th>Section</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>Title page</td>
<td>05</td>
</tr>
<tr>
<td>Introduction</td>
<td>10</td>
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<tr>
<td>Experimental</td>
<td>20</td>
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<tr>
<td>Results</td>
<td>40</td>
</tr>
<tr>
<td>Discussion</td>
<td>15</td>
</tr>
<tr>
<td>Conclusions</td>
<td>05</td>
</tr>
<tr>
<td>Overall appearance</td>
<td>05</td>
</tr>
</tbody>
</table>

Points will be taken off when parts are missing from the listed items a) to g).

**Detailed list of experiments:**

1) **Determination of iron in natural waters**

*Chemicals and Equipment*

- Spectrophotometer and Cuvettes
- 0.01M KSCN
- HCl
- conc. H₂SO₄
- FeSO₄·(NH₄)SO₄·6H₂O ferrous ammonium sulfate hexahydrate
- Na-Citrate buffer (pH=4.5)
- 10% hydroxylamine hydrochloride
- 0.3% 1,10-phenanthroline
pH paper or pH meter
500mL, 100mL(4x) volumetric flask
Balance
Pipets 0.5 and 1.0mL
Beakers to store the solutions

2) Determination of chloride ions in natural waters

Chemicals and Equipment
AgNO3
250mL volumetric flask
10, 25, 50mL volumetric pipets
250mL Erlenmeyer
pH paper or pH meter
K2CrO4
buret
HNO3
NaOH
CaCO3
Conductivity electrodes
Stirrer
Ion Selective Electrode (Chloride Electrode)
Waste container

3) Determination of pH, buffer capacity and conductivity of natural waters

Chemicals and Equipment
pH electrode and potentiometer
Buffer solutions of pH 7 and 10
Beakers to store the solutions
Buret
Ring stand, buret clamp
stirrer
HCl (0.01M and 0.1M)

4) Determination of PAH’s in environmental samples

Chemicals and Equipment
Sample
pipetts plus pipet tips for standard and sample preparation (10-200μL, 100-1000μL)
anthracene and naphthalene solid
cyclohexane
Analytical balance
5) **Photolysis of Fe(III) EDTA**

*Chemicals and Equipment*
- FeCl$_3$·6H$_2$O
- K$_3$[Fe(CN)$_6$]
- Na$_2$EDTA
- NaOH
- 10mL volumetric flasks
- Analytical balance
- Weigh boats/paper
- 5-cm long test tube
- Aluminum foil
- Sunlight or overhead projector

6) **Air Oxidation of metal ions**

*Chemicals and Equipment*
- 1pH meter
- 1 aquarium pump
- Tubing
- graduated pipets, serological and transfer pipet
- test tubes 10 cm long
- rubber stoppers
- beakers
- filtration membranes 0.45micron and supports
- microburet
- lab stand
- 10mL syringes
- 0.05M FeSO$_4$·7H$_2$O
- 1M KSCN
- 2M and conc. HCl
- 0.01M K$_4$[Fe(CN)$_6$]
- 2M NH$_4$OH
- Water
5M NaOH
3M, 0.1M and 0.01M H2SO4
0.05M KMnO4
7) **Halogenated Hydrocarbons and the Ozone Layer Depletion**

*Chemicals and Equipment*
- 2kg and black plastic bags
- 10mL syringes
- 1mL volumetric pipet
- 2mL microburets
- Three finger clamp and stand
- Magnetic bar and stirrer
- 10mL beakers
- Long wave UV pencil lamp
- Stop watch
- 10mL Erlenmeyer flasks
- Ozone generator
- 0.3 M KI
- 0.0005 M Na2S2O3 x 5H2O
- CH2Cl2
- 0.5% starch solution
- Conc. H2SO4

8) **Acid Mine Drainage**

*Chemicals and Equipment*
- pH meter
- 20mL beakers
- Magnetic stirrer
- Aquarium pump
- Beral and 2mL graduated pipets
- Spatula
- N2 gas
- FeS (solid)
- Water
- Ferric sulfate

9) **Removal of Nitric Oxide by Complex formation**

*Chemicals and Equipment*
- 5mL vials
- 20 mL filter flasks
- 10mL syringes
- 1 and 2mL pipets, graduated
- 10 mL beakers
- 25 mL Erlenmeyer flasks
Plastic septa
Well plate
Plastic cap
Spectrophotometer and cells
Rubber tubing
Magnetic stirrer
Fe(II)EDTA
KNO2
1M H2SO4
1MKOH
FeSO4x7H2O
Na2H2EDTA
Na2S2O4
N2gas
Water

10) Analysis of inorganic ions in environmental samples by ion chromatography

Chemicals and Equipment
Sample
Eluent (NaCO3, NaHCO3)
Sulfuric Acid
18mOhm water
Ion Chromatograph