

Professor Varadarajan Ravindran

## Water Chemistry and Analysis

Course Objectives and Outcomes		How well did you learn?				
		1	2	3	4	5
<p><b>Objective.</b> Students will learn various aspects of aquatic chemistry with emphasis on water quality relevant to water and wastewater treatment systems. Students will also learn to prepare laboratory reports using IBMPC or Macintosh or equivalent.</p> <p><b>Outcome.</b> How well did this course increase your ability to understand and/or do the following?</p>		<b>CIRCLE YOUR RATINGS</b> ↓ BELOW ↓				
I. Introduction to Water Chemistry						
1	General properties of water	1	2	3	4	5
2	Composition of different waters	1	2	3	4	5
3	Methods of expressing concentrations	1	2	3	4	5
II. Chemical Equilibrium						
4	Thermodynamic basis of chemical equilibrium	1	2	3	4	5
5	Enthalpy, free energy, and equilibrium constant	1	2	3	4	5
6	Non-ideal behavior of ions and molecules in solution	1	2	3	4	5
III. Chemical Kinetics						
7	Reaction mechanism	1	2	3	4	5
8	Reaction rate laws	1	2	3	4	5
9	Temperature effect on reaction rates	1	2	3	4	5
10	Catalysis	1	2	3	4	5
IV. Acid-Base Chemistry						
11	Equilibrium calculations -general approaches	1	2	3	4	5
12	Mass balance, charge balance, and proton condition	1	2	3	4	5
13	Equilibrium relationships	1	2	3	4	5
14	Graphical techniques for equilibrium calculations	1	2	3	4	5
15	Effects of temperature and ionic strength on equilibria	1	2	3	4	5
16	Mixtures of acids and base Calculations for pH determination	1	2	3	4	5
17	pH buffers and buffer Intensity	1	2	3	4	5
18	Carbonate system and its equilibria	1	2	3	4	5
19	Alkalinity and acidity	1	2	3	4	5
20	Theory of acid-base titration	1	2	3	4	5
V. Precipitation and Dissolution						
21	Equilibria of dissolution	1	2	3	4	5
22	Solubility product concept	1	2	3	4	5
23	Common ion effect	1	2	3	4	5
24	Solubility of salts	1	2	3	4	5
25	Solubility phase diagrams and their applications	1	2	3	4	5
26	Theoretical aspects of precipitation	1	2	3	4	5
27	Langelier Index	1	2	3	4	5

Lab						
28	Turbidity and coagulant dosage	1	2	3	4	5
29	Gravimetric methods for solid analysis	1	2	3	4	5
30	Colorimetric analysis of phosphate	1	2	3	4	5
31	Calcium and magnesium hardness	1	2	3	4	5
32	Aqueous chlorine forms	1	2	3	4	5
33	Chloride by argentometric method and sulfate by turbidimetric method	1	2	3	4	5
34	Chloride, sulfate and nitrate by ion chromatography	1	2	3	4	5
35	Microorganisms observation	1	2	3	4	5
36	Biochemical oxygen demand	1	2	3	4	5
37	Chemical oxygen demand	1	2	3	4	5
38	Total organic carbon analysis	1	2	3	4	5
39	Acid-base titration curves and acid-base indicators	1	2	3	4	5
40	Alkalinity and carbonate system	1	2	3	4	5

### Relationship of Civil Engineering Program Course Objectives to Outcomes

**Objective.** The Civil Engineering program is designed to teach beyond the technical content of the curriculum and prepare the students to utilize what they learn in a professional setting. Engineering projects and research activities enlist skills and demonstrate ability to understand the subject matter and communicate in a proficient manner. This course contributes to the overall program goals in the following ways.

**Outcome.** How well did this course increase your ability to understand and/or do the following?

(a)	an ability to apply knowledge of mathematics, science, and engineering	1	2	3	4	5
(b)	an ability to design and conduct experiments, as well as to analyze and interpret data	1	2	3	4	5
(c)	an ability to design a system, component, or process to meet desired needs within realistic	1	2	3	4	5
(e)	an ability to identify, formulate, and solve engineering problems	1	2	3	4	5
(f)	an understanding of professional and ethical responsibility	1	2	3	4	5
(h)	the broad education necessary to understand the impact of engineering solutions in a global,	1	2	3	4	5
(i)	a recognition of the need for, and an ability to engage in life-long learning	1	2	3	4	5
(j)	a knowledge of contemporary issues	1	2	3	4	5
(k)	an ability to use the techniques, skills, and modern engineering tools necessary for engineering	1	2	3	4	5