Military Institute of Science and Technology

Department of Environmental, Water Resources and Coastal Engineering

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EWC 105: Environmental Chemistry (1.5 credits out of 3.0)

Course Instructor: **Major Kazi Shamima Akter, PhD, Engrs**

Tentative Lecture Plan

Lec	Topics	Sub-Topics
1	Introduction on aquatic chemistry	• Defining aquatic chemistry • Scope and possible application of aquatic chemistry
2	Physical properties of water	• Boiling point • melting point • influence of pressure and solute content on boiling point, • specific weight
3	Chemical properties of water	• Dissolution in water • Major aquatic chemical process
4	Non-aqueous phases in water	• Dissolved gases in water, Solubilities of solids in water, solubility product • Colloidal suspension in water • Ionic double layer theorem for colloidal particles, charge reversal
5	Complex reactions in aqueous solutions	• Complexation reactions in water • Stability of complex ions
6	Equilibrium problem solving I	• Numerical method
7	Equilibrium problem solving II	• Log concentration approach (solving from Log C – pH diagram)
8	Aqueous carbonate system I	• Closed carbonate system (ground water)
9	Aqueous carbonate system I	• Open carbonate system (surface water) • Buffer capacity of carbonate system
10	Alkalinity and acidity	• Defining alkalinity and acidity of carbonate containing water • Concept of pH • Capacity diagram (pH contour in alkalinity – C_T diagram), • Significance and control on pH for natural water
11	Redox equilibria	• Significance of redox equilibria in natural water • Development of pE concept, electron activity
12	Water pollution and pollutants	• Sources of water pollutants, trace elements in natural water • Heavy metal contamination (Iron, Arsenic, Chromium,

		Lead, Mercury, Cadmium, Zinc etc) in water and wastewater and their effects
13	Organic pollutants in water - I	• Organic (organic complex and organometallic compounds) and inorganic (NH_3, H_2S, NO_3^-, SO_4^{2-} etc) pollutants • Concept on Dissolve Oxygen (DO), biodegradation, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD)
14	Organic pollutants in water - II	• Importance of BOD, COD • Persistent Organic Pollutants (POPs)
15	Chemistry of water quality monitoring and water quality standards	• Chemistry for monitoring of principal physical, chemical and biological parameter of water • Water quality requirements – In stream standards, drinking water standards, waste water effluent standards • EPA, WHO and Bangladesh standards (Bangladesh Environmental Conservation Rules) of water quality
16	Formation and composition of soil	• Composition of soil – inorganic and organic components • Acid-base reactions in soil • Ion exchange equilibria in soil
17	Nutrients and pollutants in soil	• Soil nutrients – Nitrogen, Phosphorus and Potassium • Fertilizer pollution • Pesticides and their residues in soil • Pollution from livestock
18	Chemical fates of pollutants	• Chemical fate and transport in water and soil • Soil-water partitioning, partitioning coefficients (K_d, K_{oc})
19	Metal dissolutions and precipitations	• Kinetics of dissolution-precipitation reactions • Solubility of salts • Solubility of oxides & hydroxides – $Fe(OH)_2$, amorphous Fe $(OH)_3$; Arsenic oxides
20	Adsorption of metals I	• Metal ions in aqueous solution and metal toxicity • Adsorption (at solid-water interface)
21	Adsorption of metals II	• Adsorption isotherms - Freundlich isotherm, Langmuir isotherm

References:

1. Chemistry for Environmental Engineering - Clair N. Sawyer, Perry L. McCarty and Gene F. Parkin, 4th ed., McGraw Hill Inc.

2. Environmental Chemistry – Stanley E. Manahan., 8th ed., CRC Press

3. Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters - Werner Stumm and James J Morgan, 3rd ed., Hoboken : Wiley, 2012

4. Environmental Engineering- Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, McGraw Hill International Edition

5. Introduction to Environmental Engineering - Gilbert M. Masters and Wendell P. Ela, 3rd ed., Prentice-Hall Inc.

6. Chemical Equilibria in Natural Waters - A Chem1 Reference Text - Stephen K. Lower, Simon Fraser University, Burnaby, British Columbia, Canada Web: http://www.chem1.com/

7. Redox Equilibria in Natural Waters - A Chem1 Reference Text - Stephen K. Lower, Simon Fraser University, Burnaby, British Columbia, Canada, Web: http://www.chem1.com/

Grading Policy:

Class Performance	5%
Attendance	5%
Class Test/ Assignment	20%
Mid-Term Assessment	10%
Final Examination	60%
Total	**100%**