WATER
By Ir Dr Anthony Ma & Mr Samuel Kwong
Syllabus

1. Water Resources
   a. Types of water resources (e.g. lakes, rivers, estuaries, oceans, wetlands, confined aquifers, unconfined aquifers)
   b. Hydrology and hydraulics of water systems
   c. Beneficial uses and related water quality requirements
      - Agricultural
      - Industrial/commercial
      - Residential (Potable water)
      - Fish and wildlife habitat
      - Recreational
   d. Sources of contamination
      - Point source (e.g. outfalls, Treatment Works' discharges)
      - Non-point source (e.g. agriculture runoff, urban storm water runoff, development air deposition)
Syllabus

2. Water Quality Assessment
   a. Water Quality Characteristics and Significance
      ➢ Physical
      ➢ Chemical
      ➢ Biological
   b. Sampling and Measurement Techniques
      ➢ Sampling issues
      ➢ Analytical issues
      ➢ Quality Assurance/Quality Control
   c. Hydraulics & Hydrology
      ➢ In-plant hydraulics (flow measurement/control, distribution)
      ➢ Surface water hydrology (run-off prediction, flow in open channels)
      ➢ Hydrology (ground water well yields, draw down, well pollution-prevention)
      ➢ Hydrology and hydraulics of water systems
3. Collection, Treatment and Disposal

a. Objectives of prevention, control & treatment
   - Point source
   - Non-point source
   - Storm water run-off

b. Pollution Prevention Methods (audits, material substitution, best management practices & systems, wellhead protection, process modifications, etc.)

c. Pollution Control and Treatment Methods
   - Collection/distribution systems
   - Water and wastewater treatment processes
     - Physical (screening, sedimentation, filtration, etc.)
     - Chemical (coagulation, neutralization, ion exchange, etc.)
     - Biological (lagoons, suspended growth reactors, fixed film reactors, natural systems)
   - Sludge management and disposal
   - Wastewater effluent management disposal

d. Water distribution and storage
4. Legislation and Policy
   a. Legal/Regulatory Compliance (general concepts, generic regulatory approaches)
      - Compliance criteria and documentation
   b. Reuse specifications
   c. Total water management
Suggested Reading Materials

• Metcalf & Eddy, *Wastewater Engineering*, McGraw Hill, Recent editions
• WHO Guidelines for drinking-water quality, fourth edition
• World Health Organization (Water resources)
  www.who.int/water_sanitation_health/resources/en
• Environmental Protection Department, HKSAR
  www.epd.gov.hk
• Water Supplies Department, HKSAR
  www.wsd.gov.hk
• Drainage Services Department, HKSAR
  www.dsd.gov.hk
• Recommended Study Materials, Text Books & Resources of Qualified Environmental Professional (QEP) Certification, The Institute of Professional Environmental Practice
Sample Questions

1. **Water Resources**

- During a spring flood, a small pond receives a large influx of nutrients. We would expect that in this lake, the growth of phytoplankton will:
  
  (a) Decrease and the growth of submerged aquatic vegetation will decrease

  (b) Decrease and the growth of submerged aquatic vegetation will increase

  (c) Increase and the growth of submerged aquatic vegetation will decrease

  (d) Increase and the growth of submerged aquatic vegetation will increase
Sample Questions

1. Water Resources

- Climate change is having an impact on the hydrological cycle. Which of the following is not true?
  (a) the moisture holding capacity of the atmosphere increases
  (b) more intense rainfall
  (c) more frequent floods
  (d) increased evaporation
  (e) smaller surface runoff
Sample Questions

2. Water Quality Assessment

• A complex trade effluent is found to have the following constituents in order of their highest to lowest concentration:
  (a) COD > TOC > BOD (b) BOD > COD > TOC
  (c) COD > BOD > TOC (d) TOC > COD > BOD
  (e) TOC > BOD > COD

• BOD$_5$ is an indicator of:
  (a) Organic matters in water (b) Microbes in water
  (c) Dissolved oxygen in water (d) The odor index of water
  (e) Nutrients content in water
Sample Questions

2. **Water Quality Assessment**

- A rough approximation for total dissolved solids (TDS) in seawater is:
  - (a) TDS = 150g/L
  - (b) TDS = 15,000mg/L
  - (c) TDS = 32,000mg/L
  - (d) TDS = 1,500mg/L
  - (e) TDS = 3,200mg/L

- NBOD in wastewater is an indicator of:
  - (a) Presence of wastes containing nitrogen
  - (b) Efficiency of wastewater treatment
  - (c) Anaerobic conditions in the wastewater
  - (d) Anoxic conditions in the wastewater
  - (e) Toxicity of the wastewater
Sample Questions

2. Water Quality Assessment

If DO$_i$ and DO$_f$ are the initial and final dissolved oxygen for a diluted wastewater sample and P is the dilution fraction, then the Biochemical Oxygen Demand (BOD) is:

(a) BOD = \((\text{DO}_f - \text{DO}_i) \div P\)  
(b) BOD = \((\text{DO}_f - \text{DO}_i) \times P\)  
(c) BOD = \((\text{DO}_i - \text{DO}_f) \times P\)  
(d) BOD = \((\text{DO}_i - \text{DO}_f) \div P\)  
(e) BOD = \((\text{DO}_f + \text{DO}_i) \div P\)
Sample Questions

3. Collection, Treatment and Disposal

• Which are not the chemicals commonly used for coagulation in water treatment?
  (a) ferric chloride     (b) lime     (c) alum
  (d) copper chloride   (e) ferrous sulphate

• Ammonia-nitrogen in wastewater can be removed by:
  1) nitrification      2) chemical precipitation
  3) absorption         4) air stripping
  5) breakpoint chlorination
  (a) 1,4,5             (b) 1,2,4,5    (c) 2,3,4    (d) 3,4,5
  (e) 1,2,3,4,5
Sample Questions

3. Collection, Treatment and Disposal

• Which of the following is not the gas generated in anaerobic process?
  (a) hydrogen  (b) methane  (c) oxygen  
  (d) carbon dioxide  (e) hydrogen sulphide

• Which of the following pollutants can be removed by ion exchange?
  (a) Suspended solids  (b) sodium  (c) ammonia  
  (d) nickel  (e) E.coli
Sample Questions

3. Collection, Treatment and Disposal

• A wastewater treatment plant has 3 grit channels in service each 1m wide. The flow velocity in the channels when the depth is 60cm and the inflow rate is $10 \times 10^6$ L/day is closest to:
  
  (a) 6 cm/s  
  (b) 10 cm/s  
  (c) 12 cm/s  
  (d) 14 cm/s  
  (e) 15 cm/s

• Which of the following treatment processes can be used to effectively remove trihalomethanes in a water supply?:
  
  (a) Oxidation with potassium permanganate
  (b) Coagulation/flocculation followed by filtration
  (c) Adsorption  
  (d) Aeration  
  (e) Sand filtration
Sample Questions

3. Collection, Treatment and Disposal

• Mixing for biological aeration tank can be provided through:
  1) Surface aerator 2) inline mixer 3) jet aerator;
  4) submersible mixer 5) air diffuser
(a) 1,2 (b) 1,2,4,5 (c) 2,3,4 (d) 1,3,4,5 (e) 1,2,3,4,5

• A rectangular settling tank is 40m L x 5m W x 4m D. When handling an inflow of 2,000 m$^3$/day, its surface-loading rate is closest to:
  (a) 1m$^3$/m$^2$.d (b) 10m$^3$/m$^2$.d (c) 12.5m$^3$/m$^2$.d
  (d) 125m$^3$/m$^2$.d (e) 100m$^3$/m$^2$.d
Sample Questions

3. Collection, Treatment and Disposal

• Which of the following method cannot be used to dewater sludge?
  (a) vacuum filter (b) centrifuge (c) belt press (d) filter press (e) cartridge filter

• A plant discharges effluent containing 26mg/L BOD₅ at 25x10⁶L/day. The weekly discharge of BOD₅ is closest to:
  (a) 45,550kg (b) 450kg (c) 4,550kg (d) 10,000kg (e) 1,000kg
Sample Questions

4. Legislation and Policy

- Which of the following is not subject to control under the Water Control Ordinance?
  
(a) discharge from a sewage treatment plant into a water body
(b) discharge from a septic tank into the soil
(c) discharge of domestic sewage into a foul sewer
(d) discharge of industrial wastewater into a foul sewer
(e) discharge of kitchen effluent from a restaurant into a foul sewer
Sample Questions

4. Legislation and Policy

- According to “Technical Memorandum – Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters”, which of the following does not belong to prohibited substances not allowed to be discharged into foul sewers?
  (a) petroleum oil           (b) flammable solvents
  (c) radioactive substances (d) pesticides
  (e) kitchen effluent
Sample Questions

4. Legislation and Policy

• Which of the following is not one of the key initiatives under the Total Water Management Strategy?
(a) To develop seawater desalination
(b) To extend the use of water-cooled ventilation
(c) To enhance water leakage
(d) To extend use of seawater for toilet flushing Water
(e) To actively consider reuse of grey water and rainwater harvesting
Q&A