Uva Wellassa University, Sri Lanka
End Semester Examination – February/March 2012

MRT 323-1 Pollutant Transport in Water

Duration: One (01) hour

Uva Wellassa University

Total four (04) Questions
Answer **all** questions

01) i. Giving examples distinguish between point and diffuse sources of groundwater contamination.

(05 marks)

ii. Graph the contaminant loading history of an accidental oil spill. Explain the reasons for the observed trends in your graph.

(05 marks)

iii. Using schematic labeled diagrams, illustrate the distribution of
(a) A soluble organic contaminant,
(b) A Dense Non Aqueous Phase Liquid (DNAPL) contaminant,
in the groundwater environment.

Describe the distribution patterns of the contaminant in each case.

(15 marks)

02) i. If a chemical is added uniformly over a river cross section, its Fickian mixing process due to dispersion can be explained by;

$$C(x,t) = \frac{M}{\sqrt{4\pi D_L t}} e^{-(x-vt)^2/(4D_L t)}$$

where $C(x,t)$ is the concentration of the chemical at distance x after time t, M is the mass of the chemical injected per cross sectional area, D_L is the longitudinal dispersion coefficient, and v is the average flow velocity of the river.

(a) Sketch the longitudinal distribution of the chemical as a graph of C vs x at times t_1, t_2 and t_3 ($t_1<t_2<t_3$). [*Hint: Above equation represents a Gaussian distribution*]
(b) Discuss your illustration.
(c) Why $(x\text{-}vt)$ is used in the exponent of the above equation instead of x?

(15 marks)

ii. (a) After 5 hours, the maximum concentration of the chemical occurs 1025 m downstream of the injection point. Calculate the average river velocity.

(b) Given that after 9.6 hours the standard deviation of the concentration distribution in the longitudinal direction is 350 m, estimate the longitudinal dispersion coefficient (D_L) of the river.

(10 marks)

03) i. Distinguish between bed load and suspended load of a river.

(05 marks)

ii. "Sediments become long-term repository of pollutant chemicals". Elaborate this statement highlighting the physical processes.

(10 marks)

iii. Explain how sediments provide a continuous historical record of the chemical and biological conditions of a water body and its environs. Illustrate your answer with examples.

(10 marks)

04) i. What are the retardation processes of pollutants in subsurface environment?

(05 marks)

ii. (a) Describe partition coefficient for linear sorption.
(b) Give an expression for the retardation factor for a linear isotherm.

(10 marks)

iii. Briefly describe three remediation techniques that can be used to clean up contaminated aquifers.

(10 marks)