CIVL446 – Environmental Engineering Ⅲ
Syllabus
2nd Semester 2011/2012

Coordinating Unit:	Department of Civil and Environmental Engineering, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	CIVL446	Year of Study:	4th.
Course Title:	Environmental Engineering Ⅲ		
Compulsory/Elective:	Elective		
Course Prerequisites:	CIVL300 Environmental Engineering I		
Prerequisite Knowledge:	Calculus through differential equations, physics		
Duration:	One semester	Credit Units:	3
Class/Laboratory Schedule:	Three hours of lecture per week.		
Laboratory/Software Usage:			
Course Description:	Many aspects of environmental engineering require a solid foundation in understanding mass and momentum transport of different processes in the environment. In addition, an understanding of the fate of pollutants in the environment is also necessary to tackle current environmental problems. Chemical reactions are therefore important in both engineered treatment processes and in natural systems in which wastes may be attenuated. Thus mass and momentum transport covered in this course is fundamental to an engineer's understanding of water and waste treatment and contaminant behavior in the environment.		
Course Objectives:	1. Focus will be on the mechanics and physics of why certain environmental conditions occur and not on the particular unit process. 2. Increase student's confidence in physical modeling. Students should be able to apply these modeling or problem solving techniques across a wide class of environmental conditions where the mechanism/physics is similar. 3. Give students a basis for understanding physical process design in advanced environmental engineering courses and a basis for improving upon existing environmental engineering process design and modeling -- especially in advanced studies.		
Learning Outcomes (LO):	Upon completion of this course, students should be able to: 1. Understanding conservation principles and applying them to transport, fate, and behavior of aqueous-phase compounds [POs: a, c, e, h] 2. Applying modeling principles to practical examples of solute transport [POs: a, c, d, e, h, l] 3. Understanding the interactions between transport processes, inter-phase mass transfer, and chemical transformation processes in environmental systems [POs: a, c, e, h] 4. Applying the transport principles to the analysis of the distribution from experimental discrete data [POs: a, c, d, e, h, l]		

Texts & References: ** recommended textbook*	1. Mark Clark, Transport Modeling for Environmental Engineers and Scientists, New York, NY: Wiley Interscience, 2009. ISBN: 9780470260722*
Student Assessment:	• Class tests: 50% • Homework: 20% • One final exam: 30%
Learning Outcome Assessment:	• Assignments, and examinations • Course evaluation
Pedagogical Methods:	☑ Lecture ☐ Guest speakers ☐ Case study ☐ Role playing ☐ Student presentation ☐ Project ☐ Simulation game ☑ Exercises and problems ☐ Service learning ☐ Internship ☐ Field study ☐ Company visits ☐ e-learning ☑ Independent study ☑Others

Major Assessment Methods:	Case Study	Role Playing	Student Presentation	Individual project/paper	Group project/paper	Simulation Game	Exercises & problems	Service learning	Internship	Field Study	Company visits	Written examination	Oral examination	Others (please specify)
Class Participation/ Discussion (0%)														
Assignment(s) (20%)												✓		
Test(s) (50%)												✓		
Final Examination (30%)												✓		
Others *(please specify)*														
Course Web: (if any)	Course materials are available in UM Moodle (http://webcourse.umac.mo/).													

Course Content: (topic outline)

Week no.	Topics	Assignment no.	LO no.
1	**Course introduction/Mass balances** Conservation law and systems approach, control volume approach, Differential element approach,source,sink,reaction and box model	1	1
2	**Particle suspensions and flow** Drag force, low Reynolds number particle dynamics and Stokes'Law;particle motions in electric fields, quiescent and perfect –mix batch sedimentation and processes; inertial forces; rotating flows and centrifugation	2	1
3,4	**Small particle interactions** Surface charges; particle size, shape and polydisppersity; double layer and colloidal stability; Schulze-Hardy Rule; Electrophoresis and Zeta potential, particle collision and fast coagulation; slow coagulation	3	3
5,6	**Adsorption, Partitioning, Interfaces** Accumulation of solutes at interfaces; adsorption Isotherm, linear equilibrium partitioning; partitioning and separation in flow system	3	3
7	**Basic fluid mechanics of environmental transport** N-S equations; fluid statics and buoyancy force; capillarity and interfacial tension; pressure; steady flows; flow shear and viscosity; slip flow; non-steady flow; Low Reynolds Number flow; ideal fluid; Bernoulli equation, steady viscous momentum boundary layers; turbulent flows	4	1,2
8,9	**Diffusive mass transport** Fick's first and second law; steady state diffusion problems; steady state mass balance; effective diffusion coefficients in porous media	5	2,3
10,11	**Convective diffusion, dispersion and mass transfer** Convective diffusion equation, Taylor-Airs dispersion; turbulent dispersion; Mass transfer in laminar flow; coefficients, models; interphase mass transport and resistance model	6	2,3,4
12	**Porous media/Filtration** Porosity, velocity and porous media; Coefficients of mechanical, molecular and hydrodynamic dispersion; Porous media dispersion equation in homogeneous isotropic medium, filtration principle	7	2,3,4
13	**Reaction kinetics** Zero-order, first-order order, second-order reactions, simple series and parallel reaction, reversible reaction, characteristic reaction times	8	2,3
14	**Mixing and reactor modeling** Simple closed reactor and residence-time distribution, measurement of residence-time distributions; residence time distribution from discrete data		4

Percentage Content of:

Math	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies	Total
10	---	50	30	10	---	100

Timetabled work in hours per week:

Lecture	Tutorial	Laboratory	Other	Total
3	---	---	---	3

Contribution to Program Outcomes:

Program Outcomes	Contribution to POs# 5 ----------> 1 Significant Least				
	5	4	3	2	1
(a) Apply knowledge of mathematics, science, and engineering	✓				
(b) Design and conduct experiments, and analyze data					
(c) Design components, systems or processes in presence of constraints			✓		
(d) Function in a multi-disciplinary team		✓			
(e) Engineering problem solving	✓				
(f) Understand professional and ethical responsibility					
(g) Communicate effectively					
(h) Understand the impact of engineering solutions to the society		✓			
(i) Recognize the need and have the ability for lifelong learning					
(j) Have knowledge of contemporary issues					
(k) Apply the skills, techniques, modern engineering tools					
(l) Use the computer/IT tools relevant to the discipline		✓			

 # Note 5: Significant contribution; 4: Supporting contribution; 3: Moderate contribution; 2: Marginal support; 1: Least support

Course Instructor(s): Dr. I. C. Lou