COURSE CONTENT

Academic Year	AY2019/20	**Semester**	2
Course Coordinator	A/P Lo Yat Man, Edmond (CEE)		
Course Code	EN4104		
Course Title	Environmental Hydraulics		
Pre-requisites	CV2015 - Hydraulics		
No of AUs	3		
Contact Hours	Lecture: 26 hrs; Tutorial: 13 hr; Lab: 0 hr.		
Proposal Date	7 February 2020		

Course Aims

This course aims to provide a basic understanding of pollutant transport processes in lakes, rivers and coastal waters. At the end of the course, you will be able to acquire sufficient knowledge to perform engineering analysis of pollutant transport in different natural water bodies.

Intended Learning Outcomes (ILO)

By the end of this course, you should be able to:

1. Identify and analyse pollutant transport processes covering diffusion and dispersion
2. Perform calculations relating to pollutant transport and mixing, and their concentrations in different water bodies covering lakes and rivers
3. Describe and examine mixing in estuarine flows
4. Identify and explain the differences between active and passive mixing of pollutants in coastal environment, and the regulations towards pollutant control
5. Perform calculations relating to pollutant transport and mixing, and their concentrations due to active mixing in coastal environment
6. Demonstrate how the calculations support the design of ocean wastewater discharge systems

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1.	Introduction to pollutant transport processes	2	1
2.	Mixing in Lakes and Bays	3	1
3.	Mixing in Rivers	6	3
4.	Mixing in Estuaries	2	1
5.	Mixing Zone Approach for Environmental Regulations in Coastal Waters	4	2
6.	Mixing in Coastal Waters	6	3
7.	Design and Maintenance Issues of Discharge Outfalls	3	2

	Total:	26	13

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO* or Graduate Attributes	Weighting	Team/Individual	Assessment rubrics
1. Final Examination	1, 2, 3, 4, 5, 6	ENE SLOs (a), (b), (c), (g) and (l).	60%	Individual	NA
2 Continuous Assessment (2 Quizzes comprising CA1 and CA2)	1, 2, 3 for CA1 4, 5, 6 for CA2	ENE SLOs (a), (b), (c), (g) and (l).	40%	Individual	NA
Total			100%		

*SLO = Student Learning Outcomes (SLO) for Environmental Engineering majors (as following EAB Student Learning Outcomes)

(a) Apply the knowledge of mathematics, natural science, engineering fundamentals, and environmental engineering specialisation to the solution of complex environmental engineering problems.
(b) Problem Analysis: Identify, formulate, research literature, and analyse complex environmental engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
(c) Design/development of Solutions: Design solutions for complex environmental engineering problems and design system components or processes with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
(g) Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and the need for the sustainable development.
(l) Life-long Learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological evolution.

Formative feedback

1. Feedback will be through dissemination of your performance in quizzes as well as review of the quiz questions in class. Follow-up consultation will be arranged as needed.
2. Besides having interactive discussion during tutorial, we encourage you to initiate individual consultation sessions on your particular learning needs

Learning and Teaching approach

Class meets thrice per week with 2 hours of lectures and 1 hour of tutorial.

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Formal lectures on the topics with examples
Tutorial	In depth discussion of tutorial problems with step-by-step solution process discussion.

Reading and References

References:

Chapra.C., "Surface water quality modeling," McGraw Hill, 1997.
Fischer, H.B., et al., "Mixing in inland and coastal waters," Academic Press, 1979.

Course Policies and Student Responsibilities

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
A/P Lo Yat Man, Edmond	N1-01b-38	6790 5268	cymlo@ntu.edu.sg

A/P Law Wing-Keung, Adrian	N1-01c-98	6790 5296	cwklaw@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Mode
1	Introduction Overall mass balance Conservative vs. nonconservative substances Decay mechanisms	1	Lectures
2	Lakes and bays Ambient motions Residence time concepts Well-mixed systems Transient and steady state response	1,2	Lectures and Tutorials
3	Lakes and bays Linear superposition Incompletely mixed systems Modeling of multiple discharged substances	2	Lectures and Tutorials
4	Mixing mechanisms in rivers Transport by advection, diffusion and dispersion Distances for complete lateral mixing Dispersion coefficient estimation	1,2	Lectures and Tutorials
5	Discharge into rivers: Plug and mixed flow regimes Point and distributed sources Superposition	2	Lectures and Tutorials
6	Discharge into rivers: Transient and steady discharges Streeter-Phelps for DO and BO	2	Lectures and Quiz
7	Estuaries: 1-D dispersive model Tidal flushing and Dilution discharge	3	Lectures and Tutorials
8	Mixing Zone Analysis Need for analysis. Characteristics of wastewater discharges and coastal waters. Terminology.	4	Lectures and Quiz
9	Introduction to buoyant jets. Concept of mixing zone for acute and chronic effects. Active and passive mixing. Dimensional Analysis	4	Lectures and Tutorials
10	Analysis of pure jets. Plane and round jets.	5	Lectures and Tutorials

	Zone of flow establishment, zone of established flow, dilution		
11	Analysis of pure plumes. Plane and round plumes. Turbulent mixing zones.	5	Lectures and Tutorials
12	Analysis of buoyant jets. Transition from jet to plume	5	Lectures and Quiz
13	Application of buoyant jet theory to design of wastewater outfall systems.	6	Lectures and Tutorials