EN4104 Environmental Hydraulics

Academic Year	2022-23	Semester	2
Course Coordinator	Prof Law Wing Keung, Adrian		
Course Type	Major Prescribed Elective / Unrestricted / Broadening and Deepening Elective		
Pre-requisites	CV2020 Water Resources Engineering		
AU	3		
Grading	Letter Grading		
Contact Hours	39 (Lecture: 26 hours & Tutorial: 13 hours)		
Proposal Date	21 December 2022		

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, student will 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	ILO Tested	EAB Graduate Attributes	Weightage	Team / Individual	Rubrics
1. CA1: Quiz 1	1, 2, 3,	(a), (b), (c), (g) and (l).	20%	Individual	N.A.
2. CA2: Quiz 2	4, 5, 6	(a), (b), (c), (g) and (l).	20%	Individual	N.A.
3. Final Examination	1, 2, 3, 4, 5, 6	(a), (b), (c), (g) and (l).	60%	Individual	N.A.
Total			**100%**		

EAB Graduate Attributes[1]	
a.	**Engineering Knowledge** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
b.	**Problem Analysis** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c.	**Design / Development of Solutions** Design solutions for complex engineering problems and design systems, components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d.	**Investigation** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e.	**Modern Tool Usage** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f.	**The Engineer and Society** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g.	**Environment and Sustainability** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
h.	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i.	**Individual and Team Work** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j.	**Communication**

[1] *Reference: EAB Accreditation Manual*

	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k.	**Project Management and Finance** Demonstrate knowledge and understanding of the engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
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 change.

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 & Teaching Approach

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.

Readings & 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 Policy & Student Responsibility

(1) General

Students are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course-related announcements for seminar sessions they have missed. Students are expected to participate in all seminar discussions and activities.

(2) Absenteeism

Absence from quiz without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

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 recognise 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 about the definitions of any of these terms, you should refer to the Academic Integrity Handbook 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	Phone	Email
A/P Law Wing Keung, Adrian	N1-01c-98	6790 5296	cwklaw@ntu.edu.sg
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Planned Weekly Schedule

Week	Topic	Course LO	Readings /Activities
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	1,2	Lectures

	Transport by advection, diffusion and dispersion Distances for complete lateral mixing Dispersion coefficient estimation		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. Zone of flow establishment, zone of established flow, dilution	5	Lectures and Tutorials
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