Academic Year	AY2023-24	**Semester**	2
Course Coordinator			
Course Code	EN3003		
Course Title	Environmental Transport Processes		
Pre-requisites	Year 3 Standing		
No of AUs	3		
Contact Hours	Lecture (26 hrs) ; Tutorial (13 hrs); Laboratory (0 hr)		
Proposal Date	12 Sep 2023		

Course Aims

This course aims to introduce material balance analyses and the principles of mass transfer and pollutant transport in the natural and engineered environmental systems. Students will be able to apply these concepts in environmental process modelling for the various environmental systems. This course covers several fundamental concepts that will reinforce your learning of other environmental engineering and water resources courses in the aspects of analyzing and solving complex problems.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) would be able to:

1. Examine environmental systems and develop material balance equations to analyse the mass and energy balances.
2. Apply mass transfer principles in modelling of various environmental transport processes occurring in the hydrosphere and atmosphere.
3. Apply several important reactor models to understand the dynamic characteristics of environmental systems.
4. Apply the material balance equations and mass transfer principles in analyzing fate and transport of pollutants in natural environmental and engineered systems.
5. Apply the material balance equations and mass transfer principles in designing and analyzing performance of engineered environmental systems.

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1.	Introduction to natural and engineered environmental systems	1	1
2.	Material balances	1	1
3.	Processes affecting fate of pollutants in environment	3	1
4.	Material flows in environmental systems: global carbon cycle; nitrogen cycle	2	1
5.	Diffusion, advection and dispersion	6	3
6.	Basic reactor theory for process modeling	3	2
7.	Partitioning of chemicals in environment and phase equilibrium	4	2
8.	Interphase mass transfer and modeling	4	2
9.	Quiz, synopsis	2	0
	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	ENE SLOs* a, b, c	60%	Individual	Appendix 1
2. Continuous Assessment 1 (CA1): Quiz	2,3,4	ENE SLOs* a, b, c	20%	Individual	-
3. Continuous Assessment 2 (CA2): Quiz	1,2,3,4, 5	ENE SLOs* a, b, c	20%	Individual	-
Total			100%		

* ENE SLOs stands for the Student Learning Outcomes of B.Eng (Environ Eng) program. See Appendix 2.

Formative feedback

Two quizzes will be conducted. The solutions to the quiz questions will be discussed in the class. You will be able to see their marked quiz papers.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Conduct 2 hours of TEL-based or normal lectures or open interactions per week for 13 weeks.
Tutorials	Conduct 1 hour per week of classroom-based discussions of tutorial questions and solutions on related topics.
Quizzes	The first quiz will be conducted after 30% of lectures are covered, while the second quiz will be conducted after 75% of lectures are covered.

Reading and References

Textbooks :
1. Course materials by instructors
2. Logan B.E. (1998) Environmental transport processes. John Wiley and Sons.

References :

1. Weber W.J. (2002). Environmental Systems and Processes: Principles, Modelling, and Design. John Wiley and Sons.
2. Schnoor J.L. (1996). Environmental Modelling: Fate and Transport of Pollutants in Water, Air, and Soil. John Wiley and Sons.
3. Nazaroff W.M. and Alvarez-Cohen L. (2001). Environmental Engineering Science. John Wiley and Sons.

Course Policies and Student Responsibilities

Absenteeism

The Quizzes are conducted during regular lecture sessions, which is a form of in-class activities. Absence from Quizzes without a valid reason will result in zero mark. 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. There will be no make-up opportunities for in-class activities.

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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. If you are uncertain of the definitions of any of these terms, you should go 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 Location**	**Phone**	**Email**

Planned Weekly Schedule

Week	Topic	Course LO	Readings / Activities
Week 1	Introduction and Material Balance	1	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 2	Principles of Mass Transport Analysis	2,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 3	Principles of Mass Transport Analysis	2,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 4	Reactions	2,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.

Week 5	1. Quiz 2. Analysis of mass transport in rivers	2,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 6	1. Analysis of mass transport in rivers 2. Analysis of mass transport in lakes and reservoirs	2,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 7	1. Analysis of mass transport in lakes and reservoirs 2. Basic reactor theory	2,3,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Recess week			
Week 8	Basic reactor theory	3	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 9	Partitioning of chemicals in environment and phase equilibrium	2,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 10	Partitioning of chemicals in environment and phase equilibrium	2,4	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 11	Interphase mass transfer	5	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 12	1. Quiz 2. Interphase mass transfer	- 5	NA Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material.
Week 13	1. Interphase mass transfer 2. Synopsis	5 -	Course materials by instructors; ppt as the main reading material and Lecture Note as supplementary material. NA

Appendix 1: Assessment Criteria for Examination (sample)

	Performance Level/Criteria				
Performance criteria	**Outstanding: 4**	**Good: 3**	**Average, meet expectation: 2**	**Below expectations: 1**	***Score (1-4)**
Able to apply reactor theory to analyse mass transfer or degradation	• Excellent ability in applying reactor theory to analyse mass transfer or degradation	• Good ability in applying reactor theory to analyse mass transfer or degradation	• Show ability in applying reactor theory to analyse mass transfer or degradation	• Unable to apply reactor theory to analyse mass transfer or degradation	
Able to analyse pollutant mass distribution in various phases	• Excellent ability in analysing pollutant mass distribution in various phases	• Good ability in analysing pollutant mass distribution in various phases	• Show ability in analysing pollutant mass distribution in various phases	• Unable to analyse pollutant mass distribution in various phases	
Able to relate theoretical concepts to real environmental phenomena	• Excellent ability in relating theoretical concepts to real environmental phenomena	• Good ability in relating theoretical concepts to real environmental phenomena	• Show ability in relating theoretical concepts to real environmental phenomena	• Unable to relate theoretical concepts to real environmental phenomena	
Able to model pollutant transport in an environmental compartment	• Excellent ability in modelling pollutant transport in an environmental compartment	• Good ability in modelling pollutant transport in an environmental compartment	• Show ability in modelling pollutant transport in an environmental compartment	• Unable to model pollutant transport in an environmental compartment	
Able to apply environmental models to analyse environmental system thermodynamics and kinetics	• Excellent ability in applying environmental models to analyse environmental system thermodynamics and kinetics	• Good ability in applying environmental models to analyse environmental system thermodynamics and kinetics	• Show ability in applying environmental models to analyse environmental system thermodynamics and kinetics	• Unable to apply environmental models to analyse environmental system thermodynamics and kinetics	

Appendix 2

ENE SLOs (2018)

a) **Engineering knowledge**: 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.

d) **Investigation**: Conduct investigations of complex problems using research-based knowledge and 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 environmental 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 the need for the sustainable development.

h) **Ethics**: Apply ethical principles and commit to professional and moral responsibilities in the environmental 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**: Communicate effectively on complex environmental engineering activities with the engineering community and with society at large, be able to comprehend and write effective reports and design documentation, and make effective presentations.

k) **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to work, as a member and leader in a multidisciplinary team.

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.