<u>**Subject Description Form**</u>

Subject Code	CSE6014
Subject Title	Environmental Fluid Mechanics
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	<u>Recommended background knowledge:</u> Students should have a knowledge and understanding of: undergraduate level of studies in engineering or science; and elements on coding using Matlab, Python, Fortran or equivalent programming languages.
Objectives	1. To provide students a better understanding of the mechanisms leading to various types of water/air dispersion behavior. 2. To provide students a rational basis for devising water/air quality analysis strategies. 3. To provide students with the knowledge about the different numerical modelling & data analysis approaches. 4. To provide students with in-depth analysis ability of dispersion processes in different contexts.
Intended Learning Outcomes	Upon completion of the subject, students will be able: a. to formulate and develop mathematical models for water/air quality prediction. b. to devise suitable measures for water/air quality applications in different research fields. c. to apply knowledge in the analysis of data and incorporate the result into aqueous reactor for application; and d. to perform critical thinking on design/research methods and solutions
Subject Synopsis/ Indicative Syllabus	<u>**Keyword Syllabus**</u> <u>1. Mass transport processes. Modelling approaches and solutions (15 Hrs)</u> Review of Diffusion and Dispersion Processes. The turbulent advection-diffusion equations and its applications for air/water quality. Dispersion of heavy/light particles in water and air: the role of buoyancy and inertia. Transport of reactive materials: models and solutions <u>2. Numerical models for water and air quality and data analysis (12 Hrs)</u> Elements of numerical methods: finite difference, finite volume and finite elements; meshless methods. Overview of modelling approaches: Eulerian and Lagrangian models. Data analysis: analysis of the velocity fields, Eulerian and Lagrangian measures of fluid mixing.

3. Applications: Water and air (12 Hrs)

Dispersion in natural water bodies and pressurized flows: Rivers mixing, mixing in Estuaries and coastal water induced by tidal, wind and wave currents

Dispersion in air: applications to atmospheric pollution and indoor air quality, Gaussian models and Lagrangian models; transport of fine particles

Teaching/Learning Methodology

1. Lectures to deliver teaching materials. Lectures will provide fundamental methods and practical approaches to the students.
2. Students should explore journal papers on new methods, advanced techniques or basic theory related to the subject content and their study background & research field.
3. Tutorials will provide chances to the students to discuss their individual applications in detail with the lecturer in person. This is useful for best fitting the needs for the students with different backgrounds. The reports will relate to the subject contents and students' background.
4. The students will be asked to directly apply the methodologies of analysis presented during the lectures by preparing their own scripts and codes (Matlab, python, Fortran, or others proposed by the students).

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a.	b.	c.	d		
1. Assignments	50%	✓	✓				
2. Project report	50%			✓	✓		
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous assessment is based on

1) Assignments based on calculations of water/air mixing applications (50%).
2) Report on individual student project, based on numerical simulations perfomed using open source models and/or script developed by the students using Matlab, python or equivalent programming languages (50%).

Student Study Effort Required

Class contact:	
▪ Lectures and Tutorials	39 Hrs.
▪ Examination	--
Other student study effort:	
▪ Reading of reference materials	36 Hrs.

	▪ Assignments	30 Hrs.
	▪ Project	30 Hrs.
	▪ Total student study effort	135 Hrs.
Reading List and References	**Books** Fischer, et al., Mixing in Inland and Coastal Waters, Academic Press, 1979. Tennekes and Lumley, A First Course in Turbulence, The MIT Press, 1972. Fernando, Harindra Joseph, ed. Handbook of environmental fluid dynamics, volume one: overview and fundamentals. CRC press, 2012. Fernando, Harindra Joseph, ed. *Handbook of Environmental Fluid Dynamics, Volume Two: Systems, Pollution, Modeling, and Measurements*. CRC press, 2012. Lynch, Daniel R., et al. *Particles in the coastal ocean: Theory and applications*. Cambridge University Press, 2015. **Journals** Journal of Geophysical Research Water Resources Research Environmental Science and Technology Journal of Fluid Mechanics Journal of Environmental Engineering, ASCE Atmospheric Environment Journal of Aerosol Science	

Revised Jul 2021