Course Syllabus

offered by School of Energy & Environment with effect from Semester A in 2016/17

Part I Course Overview

Course Title:	Data Analysis in Environmental Applications
Course Code:	SEE8212
Course Duration:	One semester
Credit Units:	3
Level:	R8
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	MA2158 Linear Algebra and Calculus and MA2176 Basic Calculus and Linear Algebra or equivalent
Equivalent Courses: *(Course Code and Title)*	SEE5211 Data Analysis in Environmental Applications
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

(A 150-word description about the course)

The course is designed for beginning postgraduate students. The course will provide students with knowledge in understanding and using statistical methods in environmental science and applications. Probability distributions, parametric tests of significance against non-parametric tests, Monte Carlo methods, spatial and time series data analysis, Principal Component Analysis, and correlation method etc. will be taught in the course facilitated by extensive use of real world problems as example. The students will be able to apply these methods in various environmental applications and learn to interpret the data to solve environmental problems.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain the concepts of basic statistical methods	10%		√	
2.	Use probability distributions, parametric, tests of significance against non-parametric tests, Monte Carlo methods to analyze environmental datasets and solve environmental problems creatively;	20%	√	√	
3.	Use PCA analysis, and correlation method to analyze environmental datasets and discover the linkage between the data results and with environmental problems.	50%		√	√
4.	Solve the real world environmental problems using statistical tools independently and creatively, and analyse the environmental problems with critical thinking. Apply these methods creatively to explain the basic physical processes in environmental science.	20%		√	√
	** If weighting is assigned to CILOs, they should add up to 100%.*	100%			

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lectures	Explain key concepts, such as useful normal distribution, tests and other environmental analysis method	√	√	√	√	2.0 hrs/wk
Group Discussion	Apply these methods to discuss and solve the related environmental problems		√	√		0.3 hrs/wk
Tutorials	Solidify students' concepts with practice	√	√	√	√	0.7 hrs/wk

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting*	Remarks
	1	2	3	4		
Continuous Assessment: 40%						
Assignment	√	√	√	√	40%	
Examination: 60% (duration: 2 hours , if applicable)						
** The weightings should add up to 100%.*					100%	

To pass a course, a student must do ALL of the following:

1) obtain at least 30% of the total marks allocated towards coursework (combination of in-class exercises, case study, oral presentation, if applicable);
2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3) meet the criteria listed in the section on Grading of Student Achievement.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Adequate (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	Ability to understand the scientific principles and the working mechanisms	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Final exam	Ability to solve physics and engineering problems by using the related principles	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

1.1 Probability distributions

(1) Introduction - concepts of probability, random variables and probability distributions.

(2) Probability distributions (discrete and continuous): normal distribution, Central Limit theorem, *t*-distribution, and Fisher's F-distribution, gamma and other distributions.

(3) Application of probability distributions in environmental or related data analysis, e. g. particle size distributions, detection limit of environmental analysis.

1.2 Tests of hypothesis

(1) Type I error, Type II error, level of significance,

(2) One tailed tests and two tailed *t*-tests.

(3) Analysis of variance (ANOVA)

(4) Boot strap and Monte Carlo methods.

(5) Application of test of hypothesis in environmental or related data analysis, e.g. compliance of environmental standards etc.

1.3 Regression analysis

(1) Simple regression - estimation of regression line, analysis of variance, confidence interval for regression coefficients, and confidence band for regression line.

(2) Multiple regression - estimation of regression plane, partial correlation, and multiple correlation.

(3) Nonlinear and categorical regression

(4) Application of regression analysis in environmental or related data, e.g. calibration of environmental analysis.

1.4 Spatial and time series data analysis

(1) Difference of random, uniform and clustered spatial distribution;

(2) Significance tests on the various spatial distributions;

(3) Trend and seasonality analysis of time series data;

(4) High time resolution data analysis methodology for background and spike detection

1.5 Principal Component Analysis

(1) Introduction of Principal Components Analysis- rotated and complex empirical orthogonal functions, singular Value Decomposition, canonical Correlation Analysis.

(2) Application of PCA on complicated environmental data sets, e.g. source identification of air pollutants etc.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Statistics for Environmental Engineers, Second Edition **Publisher:** CRC Press; 2 edition (January 29, 2002) **ISBN-13:** 978-1566705929

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	
2.	
3.	