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.	

Explanatory Notes

1. Course Title

Full title of the course.

2. Course Code

Courses other than Gateway Education Courses

An alphanumeric code normally using the department code as a prefix, followed by 4-5 digits, where the first digit indicates the level of the course.

For example, the course "Operating Systems" may have a course code of "CS5001". "CS" is the department code for the Department of Computer Science. "5" after the department code is the level of the course, and in this case the course is at the level of P5, and "001" is the sequence number assigned to the course.

Gateway Education Courses

An alphanumeric code using "GE" as a prefix, followed by 4 digits, where the first digit indicates the level of the course and the second digit indicates the area.

For example, the course "Accounting in Everyday Life" will have a course code of "GE1222". "1" is the level of the course, and the digit that follows is the GE area. In this case, the course is at the level of B1 and falling into Area 2. The last 2 digits "22" is the sequence number assigned to the course.

3. Course Duration

This refers to the duration of the course in terms of number of weeks or semesters.

4. Credit Units

Number of credit units assigned to the course, with 1 credit unit earned by approximately forty to fifty hours of student work.

5. Level

The level of a course shows its degree of academic difficulty. The following levels should be used:

Associate Degree courses can have levels of A1 or A2;
Bachelor's Degree courses can have levels of B1, B2, B3 or B4;
Taught postgraduate courses can have levels of P5 or P6; and
Professional Doctorate and Research Degree courses can have levels of D8 and R8 respectively.

6. Proposed Area

This section applies to Gateway Education courses only. Insert "1" for the single primary area, and "2" for the secondary area if applicable. Students will only earn credit units from the primary area.

7. Medium of Instruction and Assessment

Unless otherwise determined by Senate for a specific course, the medium of instruction and assessment at the University is English.

8. Prerequisites

Courses that students must pass before being allowed to take the current course. A rigid structure of prerequisites may unintentionally hinder a student's progress and limit flexibility in the choice of courses. Furthermore, the timing of the availability of the prerequisite courses as well as the current course would be critical. Departments should therefore be careful when defining extensive prerequisites for courses.

9. Precursors

Courses that students are advised to take and pass before they attempt the current course. In general, precursors are more flexible in allowing student choice and progression. They also serve as indicators of the requirements of the current course.

10. Equivalent Courses

Courses of same level where there is sufficient overlap in content that students may register in the course to meet degree/programme requirements, to recover a failure or to improve a course grade.

11. Exclusive Courses

These are courses which have sufficient overlap in their content to make it inappropriate for students to earn credit units for more than one of these courses. Students thus should not be allowed to enrol in them.

12. Abstract

The abstract is a short description about the course.

13. Course Intended Learning Outcomes (CILOs)

CILOs state what the student is expected to be able to do at the end of a course according to a given standard of performance. Outcomes should be achievable and assessable. They should be clear to students on the learning outcomes expected at the end of the course and also clear to staff to enable them to design appropriate teaching and learning activities (TLAs) and assessment tasks which facilitate the achievement of CILOs. It is important to ensure that Course ILOs address Programme/Major ILOs. Use verbs from the SOLO Taxonomy in defining Learning Outcomes. The Programme/Major leader has the responsibility to ensure and can demonstrate a proper mapping between the CILOs with the Programme/Major and/or Minor Intended Learning Outcomes.

Weightings can be assigned to CILOs according to their relative importance to the course.

14. Teaching and Learning Activities (TLAs)

TLAs are designed to align with CILOs to facilitate student's achievement of those outcomes. TLAs could be teacher, peer, or self-initiated and take various formats such as project work, case studies, lectures, tutorials, practicals, placements, problem-based learning, studio, etc. The choice of TLAs should facilitate active learning and the achievement of CILOs. Some TLAs may address more than one CILO.

15. Assessment Tasks/Activities

Assessment tasks or activities are designed to align with the CILOs to provide evidence on how well each student has achieved the CILOs. Such evidence could be provided by project work, case studies, assignments, examinations, laboratory work and reports, practicals, practicum, etc. The choice of Assessment Tasks should relate directly to the learning outcomes of the course. "Remarks" could include information such as when a task is to be performed, due dates, word limit of the assessment tasks/activities, assessed on a Pass/Fail basis, etc., as applicable.

16. Assessment Rubrics

Grading of student achievements is based on student performance in assessment tasks/activities with the rubrics defined and be in accordance with the Academic Regulations for Associate Degrees, Bachelor's Degrees, Postgraduate Degrees, Professional Doctorate and Research Degrees, where appropriate. Information on grading of courses can be found at the end of the explanatory notes.

17. Notes for Dissertation-type Courses

Courses may be designated "dissertation-type" courses in the course catalogue. Dissertation-type courses relate to independent work which takes a variable time to complete. Sections of "Teaching and Learning Activities" and "Assessment Tasks/Activities" should be replaced with information relevant to such courses, including a specification of a ***normal duration*** for course registration and a ***maximum duration*** for course registration, both in terms of the number of semesters. In all cases, the Course Syllabus for dissertation-type courses should specify that students are not permitted to repeat a dissertation-type course.

18. Keyword Syllabus

An indication of the key topics of the course. It is provided to let students make informed decisions of whether to take the course. Variations from the indicative topics would be identified in the teaching plan.

19. Amendments/Revisions to Course Syllabus

Amendments or revisions to the information provided in the Course Syllabus are subject to the procedures outlined in the University's QA Principles, Policies and Practices. College and School Boards should consider delegation of authority to Programme Committees, College/School Validation and Monitoring Committees, academic units (in particular for Part III where updates are expected to be quite frequent), as necessary to facilitate innovation and change as appropriate.

Grading of Courses

- Courses are graded according to the following schedule:

Letter Grade	Grade Point	Grade Definitions	
A+ A A-	4.3 4.0 3.7	Excellent	Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.
B+ B B-	3.3 3.0 2.7	Good	Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with literature.
C+ C C-	2.3 2.0 1.7	Adequate	Student who is profiting from the university experience; understanding of the subject; ability to develop solutions to simple problems in the material.
D	1.0	Marginal	Sufficient familiarity with the subject matter to enable the student to progress without repeating the course.
F	0.0	Failure	Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; limited, or irrelevant use of literature.
P		Pass	"Pass" in a pass-fail course. Courses to be graded on a pass-fail basis for a programme are specifically identified under the programme in the course catalogue.
Operational Grades			
IP	In Progress	An IP grade is shown where students will register for the same course in subsequent semesters to complete the assessment of the course.	
I	Incomplete	A grade of incomplete may be granted (1) where there are extenuating circumstances that have prevented a student from completing required work, or attending the examination; (2) at the discretion of the Assessment Panel. Where an "I" grade is assigned, the Assessment Panel will approve a schedule for the completion of work, or a supplementary examination. An alternative grade should be assigned no later than four weeks after the “I” grade is first reported or as soon as practicable thereafter.	
S	Dissertation Submitted	In a dissertation-type course, an S grade is assigned by the Course Leader when a student's dissertation has been submitted for assessment.	
TR	Credit Transfer	Assigned when a student is granted transferred credit units for the course.	
Z	Exemption	Assigned when a student is exempted from the course.	
AU	Audit	An audited grade is assigned when an auditing student has completed the conditions	

		established at registration as an auditor. No assessment is made or grade awarded for auditing.
X	Late Drop	Assigned when a student is permitted to drop the course after the add/drop deadline.
WD	Withdrawn	Assigned when a student has registered for the course in a semester/term and subsequently submitted a notification of withdrawal from the University.

- Students assigned a grade of D or better, or a Pass grade in a pass-fail course, earn credit units for the course. Grades of F, IP, I, S, Z, AU, X and WD do not earn credit units.

- A grade with an asterisk (e.g. B+*) is excluded from the calculation of the GPA. The credits earned will not be counted toward the minimum credit requirement for graduation but will be counted toward the maximum number of credit units permitted.

- Grades of P, IP, I, S, TR, Z, AU, X and WD are not counted in the calculation of a student's CGPA. Grades of F are counted, unless the fail is recovered under the section of "Repeating Courses to Improve Grades" in Academic Regulations.

- Grades of P, IP, I, S, TR, Z, AU, X and WD are not counted in the calculation of a student's SGPA.